January 1961

Insulation

Pictorial conference report . . . page 35

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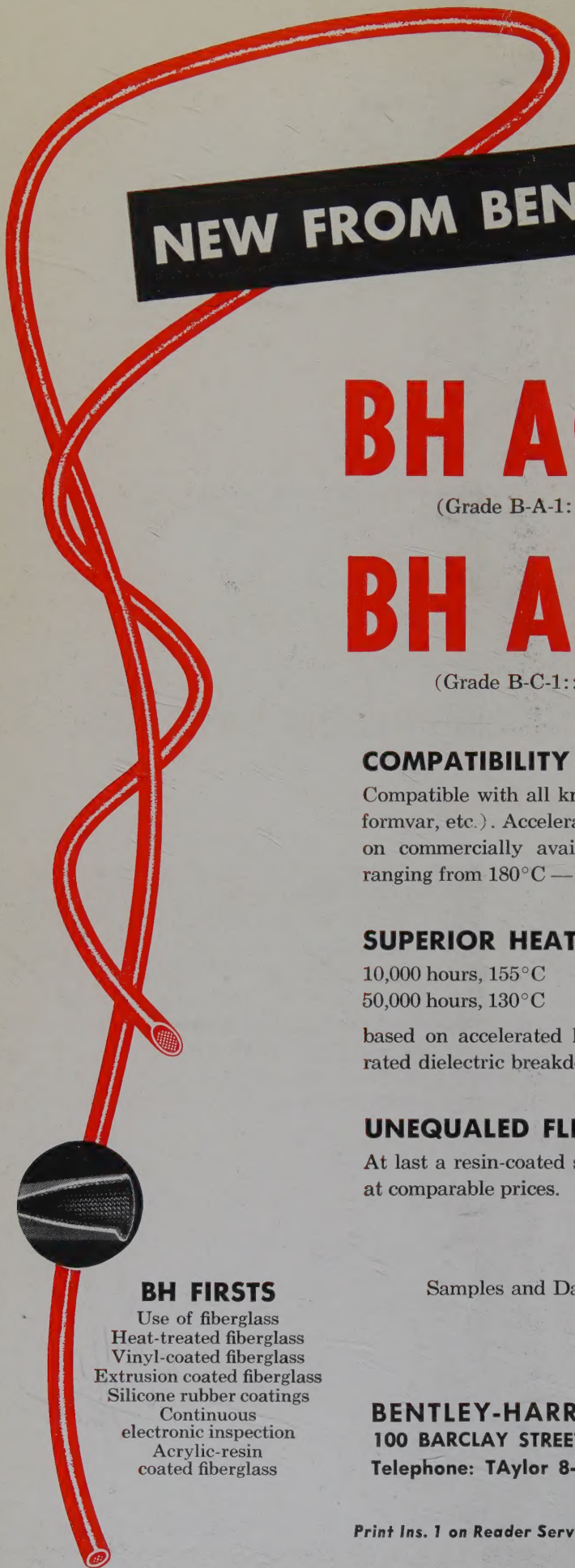

NEW FROM BENTLEY-HARRIS . . .

BH ACRYL-A

(Grade B-A-1::7000 volts minimum average)

BH ACRYL-C

(Grade B-C-1::2500 volts minimum average)

COMPATIBILITY UNLIMITED

Compatible with all known wire enamels (polyester, epoxy, formvar, etc.). Accelerated heat aging has disclosed no effect on commercially available magnet wire at temperatures ranging from 180°C — 280°C.

SUPERIOR HEAT LIFE

10,000 hours, 155°C
50,000 hours, 130°C

based on accelerated heat aging tests — end point: ½ of rated dielectric breakdown (ASTM D350)

UNEQUALED FLEXIBILITY

At last a resin-coated sleeving as flexible as Vinyl-glass and at comparable prices.

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Use of fiberglass
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Vinyl-coated fiberglass
Extrusion coated fiberglass
Silicone rubber coatings
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Acrylic-resin coated fiberglass

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SELFISH SERVICE

here are those who think Prehler goes too far in the service it provides customers (and would-be cus-omers). But Prehler is a business and has a rather selfish, long range view of service. For we're just old ashioned enough to figure that more and more service will mean more and more customers. That's why ectronic equipment was installed to control inventories and make sure the insulation material you need in stock. That's why busy Prehler sales engineers are never too busy to toss urgently needed shipments to their cars for prompt delivery. That's why the factories represented by Prehler will work for weeks o solve your problem. And that's why Prehler men will do everything possible—in advance—to make sure ou are satisfied. The service is free . . . just phone or write your nearest office.

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Branch Offices

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Detroit 2, Mich., 411 Piquette Ave., TRinity 5-4020

St. Paul 1, Minn., 367 Grove St., CApital 5-4321

Milwaukee 12, Wis., 3379 N. Green Bay Ave., FRanklin 4-3100

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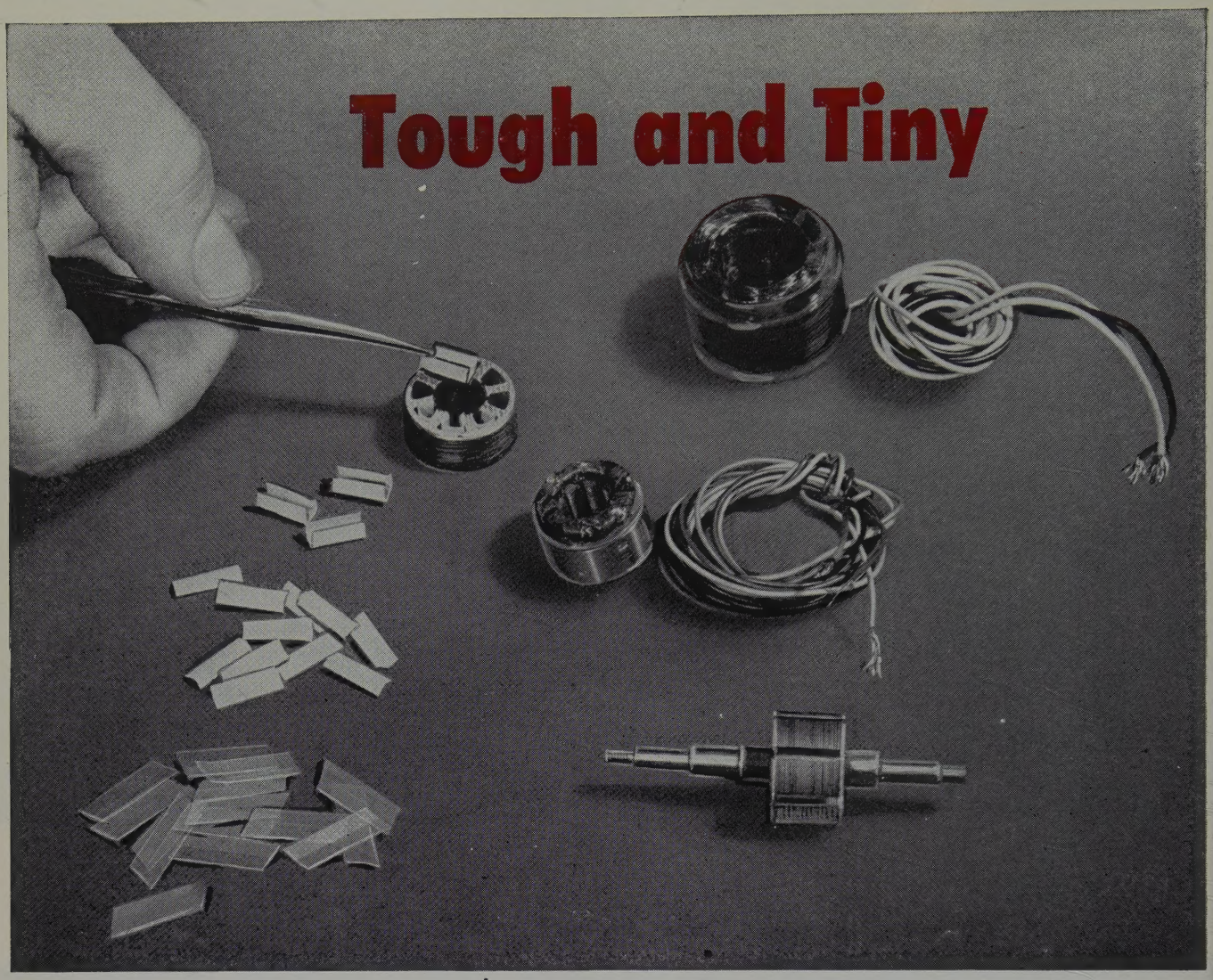
(Use Cleveland Address)



INMANCO miniature motor slot insulators are made from thin, tough, heat-resistant Mylar and Teflon films

where miniaturization is a "must"—specify

Inmanco®

Motor Slot Insulators for...

- miniaturization requiring insulators both thin in thickness yet tough and durable
- resistance to electrical breakdown over a wide range of temperatures
- severe conditions where units are subject to vibration, shock, high temperatures.

More and more, miniaturization is becoming an important consideration in the fast-moving electrical and electronic fields. Uniformly accurate INMANCO engineered motor slot insulators invariably fill the bill where miniaturization is a "must" because they can be precision fabricated from materials which are both thin in thickness and heat resistant in character as well as being tough and durable. Because of the wide choice of these materials, INMANCO motor slot insulators can be made with the exact properties required for the specific miniaturized application. Other typical materials from which you may choose are glass cloths coated with Teflon, epoxy, or isocyanate resins; or any of the various Mylar Paper, Mylar Dacron, or Mylar Cloth Combinations. Specify INMANCO fabricated parts whether the job is miniature or mighty. Write for INMANCO Product *Write for INMANCO product information or send blueprint.*

"Mylar®" and "Teflon®" are Du Pont trademarks

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Print Ins. 3 on Reader Service Card

Insulation

For the Electrical and Electronic Industries

Lake Publishing Corporation, 311 East Park Avenue, Libertyville, Illinois, January 1961

Publishers of Insulation, Insulation Directory/Encyclopedia, Plastics Design & Processing

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Advertising Sales Offices: See page 82.

From the Editor

Opinions and Rambling Thoughts

The mail this month brought an unusual collection of news releases. Here are a few comments on them . . . some serious . . . some tongue-in-cheek.

Sad, Sad Future

One Bernard M. Goldsmith, president, Nytronics Inc., predicts a sad future for more than 90% of the thousands of electronic component manufacturers—that's the percentage he claims will disappear from the American business scene in the next ten years. He states, "Accelerated by the relentless demand for standardized products, custom manufacturing houses will either convert to standardized product lines or fall by the wayside."

We will not argue with the trend predicted by Goldsmith, but in our opinion the 90% figure he offers is completely wrong. Thank goodness everyone is still entitled to opinions but let's keep them reasonable . . .

And for every one of those present-day manufacturers who disappears from the American scene, we strongly suspect that there's a guy who doesn't know any better with a garage, five bucks, a work bench, and an idea who is ready to move in to the scene.

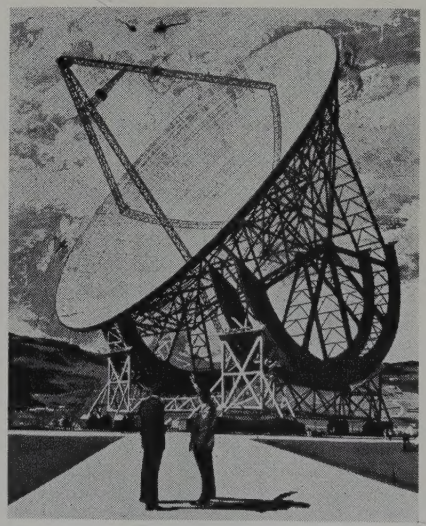
Electronic Pills Diagnose Ills

In a speech before the winter conference of the Electronic Industries Conference, Dr. Edward G. Witting, deputy director of Army research, threw out the possibility that tiny electronic circuits introduced into the human body by swallowing or injection might aid physicians in diagnosing disease. "Radioactive tracer chemistry and biology already have advanced the work of physiologists—why not microelectronic circuits?" Dr. Witting asked.

We do not question the excellence of Dr. Witting's idea but far be it from us to let a question go unanswered. Why not? . . . because it will take 11¼ years before engineers will universally recognize the need for new environmental test conditions (inside stomach conditions) for testing electronic components . . . because it will then take 24½ years for engineers to agree on new and appropriate test procedures . . . and finally, because it will take another 45⅜ years before all concerned will be able to agree on the one stomach which is truly representative for testing purposes—and by that time, the poor possessor of the representative stomach will have departed this world.

Some Dish

The picture is the artist's concept of the world's largest radio-telescope being built for the U. S. Navy at Sugar Grove, W. Va. Higher than a 60-story building, the telescope has an aluminum reflector dish covering seven



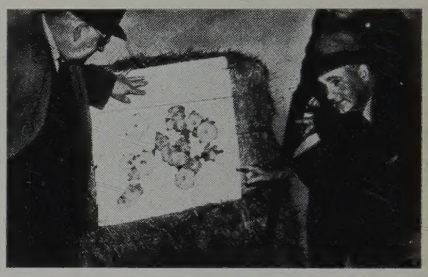
acres—enough room to house Yankee stadium. More than 2-million pounds of aluminum will be used. If this makes no one else happy, it certainly should at least please Reynolds Metals Co.

Noiseless Drums

Du Pont, which for some time has graciously accepted the praise of electrical insulation users for the development of "Mylar" polyester film, is now seeking the gratitude of long-suffering parents and neighbors through the use of the film for a sound-deadening, virtually noise-free covering material for drums. This development supposedly is the answer for would-be drummers whose Krupa-like talents are not yet appreciated by fellow residents in a four-block radius. Next thing you know the record companies will be putting out grooveless recordings for the highest hi-fi addicts.

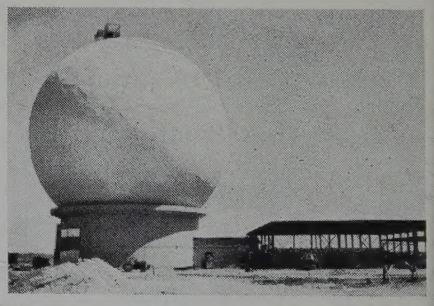
Light Sources for Cities With Playful Police Departments

The photo is designed to prove that the firepower of a police riot gun cannot extinguish the light of a Panelescent lamp, the new solid light



source produced by Sylvania Electric Products Inc. We understand the new product might be test marketed in Leopoldville.

That thing that looks like a giant golf ball is a 110-foot diameter spherical radome built by Goodyear Aircraft Corp. to house the research and development model of the Zeus acquisition radar installed at White Sands Missile Range, N. M. The pro-



tective structure contains 445 triangular glass fiber reinforced plastic panels attached to a welded random space-frame. Weight is 220,000 pounds. It covers a surface area of 32,813 square feet and was built to withstand −65°F to +150°F.

CHECKMATE

in wire capping

NEW *heat-shrinkable....*

THERMOFIT CAPS

RAYCLAD TUBES
INCORPORATED

A SUBSIDIARY OF RAYCHEM CORPORATION

THERMOFIT CAPS are short, irradiated polyolefin sleeves, sealed on one end, which shrink to less than one-half of their original diameter upon the brief application of heat. Upon shrinking, they produce a tough, moisture-tight end-seal with outstanding insulation properties for the most difficult environments.

THERMOFIT CAPS reduce required space to a minimum; conform to variable contours; provide quick and uniform application; are available in standard color-coded sizes; and are low in price.

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News and Views

Plastic Prices Down

Welcome news for some insulation users . . . more plastic prices are moving down . . . primarily as a result of increased commercial production.

Du Pont has reduced the price of type C "Mylar" polyester film by 25 cents a pound in 25 and 35 gauges, and 15 cents a pound in 75 gauge. This type is used as a dielectric in capacitors. Type A film has been cut 20 cents a pound in 50 gauge, and 25 cents a pound in 300, 500, 750, and 1000 gauges. This type is used for wire and cable insulation, motor insulation, flexible laminations, and other applications. The current reductions bring the price down in the range of $1.55 to $3.65 a pound.

Both polycarbonate resin producers—Mobay Products Co., a subsidiary of Mobay Chemical Co., and the Chemical Materials Department of General Electric Co.—have reduced their prices by up to 25 cents a pound. Lowest price for natural color is now $1.30 a pound and for colors $1.50 a pound.

The price of styrene/butadiene latex was reduced an average of two cents a pound by Dow Chemical Co. The previous tank car price was 29½ cents a pound.

Low Cost Film Resistors

Corning Electronic Components has begun mass production of tin oxide film resistors for sale at prices competitive with carbon composition resistors. The half-watt and one-watt units are said to provide more power dissipation in smaller case sizes. They are coated with silicones that resist solvents used by printed circuit manufacturers.

500°C Ceramic Insulation Developed for Aircraft Generator

According to General Electric Co., new ceramic insulations capable of withstanding 500°C have been developed for use in Mach 3 aircraft and other future missile and space applications. Mach 3 operation is expected to involve temperatures of 500°C, and in hot spots up to 600°C.

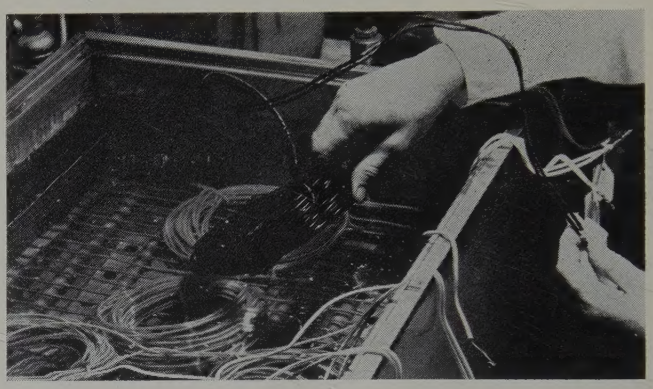
An inorganic sheet material consisting of a composite of flake mica and glass cloth bonded together with an inorganic cement was developed for the generator ground and phase insulation.

For the encapsulating material, a ceramic cement was successfully developed—the formulation consisted of equal parts of magnesium oxide and glass frit, with a binder of aluminum phosphate in phosphoric acid. The cement had a pot life in excess of 30 minutes. It showed less than one percent moisture absorption after two hours immersion in boiling water. In laboratory tests the ceramic materials withstood 40 hours operation at 500°C and remained in good operating condition after many additional hours of testing at 300 to 500°C.

The completed insulation system was installed in 40 kva generators and successfully tested under aircraft environmental conditions.

Easy Processing, High Density Polyethylene Wire Insulation

Tests on high density polyethylene coated wire at Goodrich-Gulf Chemicals Inc., reportedly show that a new type of material has dielectric and other properties which make it suitable for wire and cable shielding. It is said to offer the inherent advantages of the high density material



—resistance to abrasion, high temperatures, cut-through, environmental stress cracking, and thermal embrittlement —but can be processed with the same ease as conventional polyethylene.

New Low Temperature Phenomenon

An unexpected "switch-back action" or negative resistance region when current is passed through a metal-dielectric-metal sandwich at temperatures approaching absolute zero has been observed by physicists at Arthur D. Little Inc. Application of this negative resistance phenomenon might lead to the development of a whole new family of simply constructed components compatible with present low temperature electronic circuits such as cryotrons.

The new device, called a tunneltron, was made by evaporating an aluminum strip onto a glass substrate, oxidizing it in air to form a thin surface layer of dielectric aluminum oxide, and then evaporating a thin cross strip of lead on top of the aluminum oxide. The tunneltron has extremely low power requirements and should operate at very high frequencies. The observed negative resistance effect stems from the ability of electrons to pierce or "tunnel" through extremely thin layers about a millionth of an inch thick of material that is normally considered insulating. Observation of this tunneling current as it depended on the voltage applied across the experimental sandwich revealed a region where the current "switched-back," a region of negative resistance, provided the two metals were maintained in a superconductive state.

Heat-Resistant Varnish Solves Bonding Problem in Small High-Speed Motors

An interview with Robert M. Henry, District Sales Manager
Schenectady Varnish Company, Inc., Schenectady, N. Y.

Impregnating varnishes used in more efficient, small high-speed motors must hold the coils rigidly in place despite higher operating temperatures. As described below ISONEL 31 Polyester Varnish shows outstanding bond strength in Helical Coil Bond Test.

Q. What is the significance of the bonding strength of an insulating varnish?

A. In rotating equipment this is a measure of its ability to hold the coils of a motor in place without cracking or losing adhesion—despite severe environmental stresses.

Q. Is there a standard test for this?

A. A number of methods have been devised — splints, bundles, screwhead and Helical Coil are the best known. The latter is relatively new, but is in wider use because it more closely resembles the actual insulating varnish bond in electrical equipment.

Q. Why is bond strength emphasized for the newer small motors?

A. It applies equally to motors of all sizes, of course. In small motors though, as operating temperatures rise, conventional varnishes deteriorate, coils are spun loose at high speeds and failures result. The Helical Coil Bond Test provides reliable data on the ability of a varnish to maintain its bond strength at temperatures of 155 C or more.

Q. Since practically all rotating equipment involves both a magnet wire enamel and an impregnating varnish, is this test useful for both?

A. Yes, considerable data has been accumulated for various varnish/enamel combinations in our Electrical Testing Laboratory, some of which is shown below.

Q. Which combinations seem best suited for small motors?

A. In tests of various magnet wire enamels with a polyester varnish, a polyvinyl acetal enamel showed the highest bond strength. (See Fig. 1). It was closely followed by a polyester enamel.

Q. How about other varnishes?

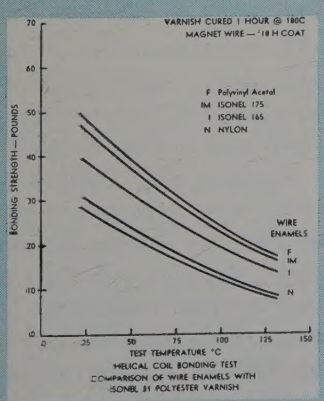
A. Because of their hardness, phenolic varnishes have been used mostly for small high-speed motors. In Fig. 2, however, you see the effect of heat aging on a phenolic vs. our ISONEL* 31 High-Bonding Varnish. Lower to begin with, the polyester increases in bond strength for over 200 hours at 200 C, before bond strength is affected.

Q. What is your conclusion, then?

A. It depends on the application, of course. In general, we believe best results on small motors are obtained with a polyvinyl acetal or polyester enamel with ISONEL 31 Varnish.

** Reg. T. M., Schenectady Varnish Company, Inc.*

DIP-COATER applies ISONEL Varnish to enameled wire samples.



◀ **Fig. 1—Comparison of bonding strength of various wire enamels with ISONEL 31 High-Bonding Varnish.**

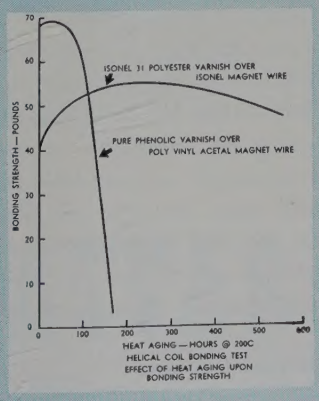


Fig. 2—Effect of heat aging on bonding strength of phenolic varnish and ISONEL 31 High-Bonding Varnish. ▶

Consult your wire supplier for data on ISONEL enameled wire.

Inquiries should be directed to: Section E-11

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Insulating Varnishes and Wire Enamels for the Electrical Industry — Since 1906

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Insulation Forum

This regular monthly feature is built around a timely question concerning the electrical insulation field. Your suggestions for future questions and participation are invited. This month's question is:

What do you think was most important to insulation progress in 1960, either in your particular field or from the over-all industry standpoint, and why?

Murray Goldfinger

Chemist, Specialty Electronics Development Corp., Brooklyn, N. Y.

"From the viewpoint of electrical insulating compounds needed to insure proper operation of electronic components under varying temperature and climatic changes, I feel that the growth and improved versatility in the field of epoxide, silicone, and polyurethane resins simplifying the task of protecting electronic components has contributed greatly to insulation progress in 1960. From resin systems that originally could be used in certain controlled conditions we now have available systems that can operate at temperatures as low as —80°C and as high as +250°C. Resins previously not able to withstand the mildest of thermal changes have been replaced by formulations that can withstand requirements demanded under military specifications.

"With the missile age and the need for still greater heat resistant materials, great amounts of research have been and are at present being carried out in the field of higher temperature insulating materials and compounds. While 1960 has produced a great advance in insulating materials and compounds, we can look forward to still more research and development in the field of insulation which will extend still further our scope in the manufacture of components."

Jerrold L. Colten

Chief Engineer, Welcraft Products Co. Inc., New Carlisle, Ind.

"Progress advantageous to electrical insulation has been made in the room temperature vulcanizing silicones. The improvement in tensile strengths has brought them to the place where the regular silicones were only a few years ago. The introduction of low viscosity materials which can be used readily in potting, impregnating, and encapsulation is of importance. At the other end, stiff pastes having very respectable durometers have come into being.

"The excellent electricals, coupled with high ozone resistance, make the RTV compounds well worth considering for use in high voltage insulations.

"Not to be ignored is the fact that no exothermic reaction takes place that could be damaging to the parts being encapsulated."

George Voida

Plastic Encasement Supervisor, Sandia Corp., Albuquerque, N. M.

"During 1960, the application of flexibilized epoxy and polyurethane resin systems was a significant contribution to the plastic encasement of electronic assemblies. The low viscosity formulations adopted for this purpose are cured with appropriate hardening agents in the 130 to 180°F temperature range.

"Electronic assemblies encased in the resins operate safely when cycled from 160 to —65°F.

"Transparency of the resins permits visual inspection of the encased equipment. The cleanliness of the piece parts and the workmanship of the assembly can be determined. Any damage sustained by components, fragile wire leads, adhesives, and by soldered junctions during assembly and during shipment can also be determined by visual inspection.

"Location of electrical failures can be found, whereas in filled resin systems isolation of such breakdowns is virtually impossible.

"The transparent castings are extremely valuable because physical changes such as cracking of glass tubes or glass seals, chemical changes such as corrosion of metal parts or incompatibility of insulating materials, and thermal degradation such as produced by localized heating may also be observed. These changes may be attributed to exposures in assembly, testing, or functional operation.

"The transparent, flexibilized resins are available commercially as two-component systems and have been used successfully in pre-production castings."

George Richards

Design Engineer, Power Supply Group, Capitron Div., AMP Inc., Elizabethtown, Pa.

"It is very difficult to select one development as contributing the most to progress in the insulating field in 1960. With new products and product refinements reported daily in high temperature potting compounds, insulating materials, etc., I would select the development of a self-bonding class B magnet wire as contributing the most in my area of design.

"The reliability of oil filled high voltage transformers and chokes has always presented the problem of anchoring the leads, due to the fact that pressure-sensitive and thermosetting tapes recommended for use in oil leave much to be desired. Also, in using very fine wire the use of tape causes considerable buildup in relation to total wire buildup.

"The adhesive used on this self-bonding wire is a "B" staged epoxy, which can be cured into a homogenous mass by heat curing or a solvent process. Besides giving a strong turn-to-turn bond on each layer, it offers an advantage of great importance in that the coil can be pre-shaped to a desired configuration, and once the adhesive is cured, the coil will maintain this shape.

"Preliminary testing has indicated that for high voltage electronic transformers and chokes, the self-bonding wire gives a rigid coil that will meet military standards with all the design advantages of transformer oil."

J. Popkin-Clurman

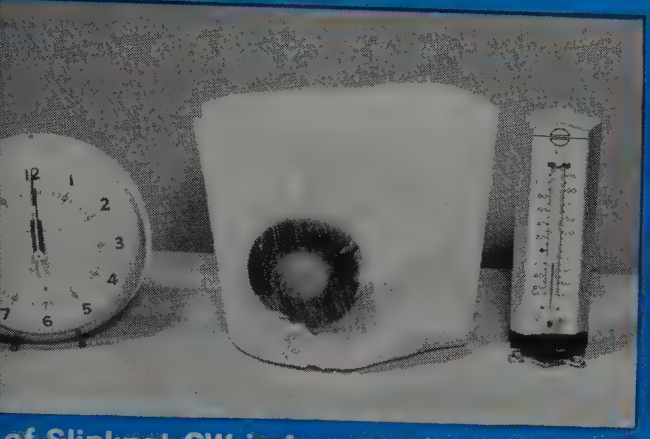
President, Telechrome Mfg. Corp., Amityville, L. I., N. Y.

"One of the most dramatic applications of insulation has been the dual use of beryllium oxide as a low loss insulator at radio frequencies and as a high heat transfer medium to heat sinks for the cooling of transmitting tubes without the necessity of using air or liquid cooling. This has made it possible to operate missile and satellite telemetry equipment in heretofore impossible environments.

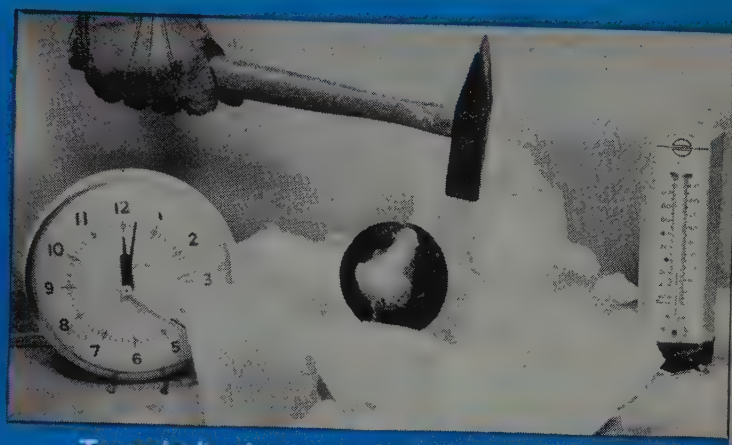
"Another highly significant development (Jerome Goodman, Radiation Research Corp., New York) is a new technique for semi-vacuum deposition of insulating materials in controlled thicknesses by making use of a glow discharge. This process should make possible insulation applications in entirely new fields and result in families of materials based upon molecular insulations which were never before possible."

IEN IT'S COLD - THE SPLICE WILL HOLD
TH SLIPKNOT CW
IYL ELECTRICAL TAPE!

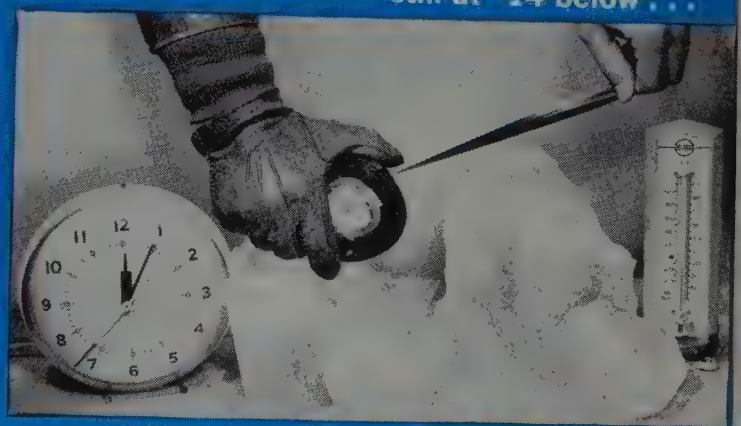
MARKABLE VERIFIED TESTS PROVE THAT UL-APPROVED
KNOT CW WORKS PERFECTLY UNDER THE
T SEVERE COLD-WEATHER CONDITIONS!



of Slipknot CW is frozen solid in a block at 14° F below zero.



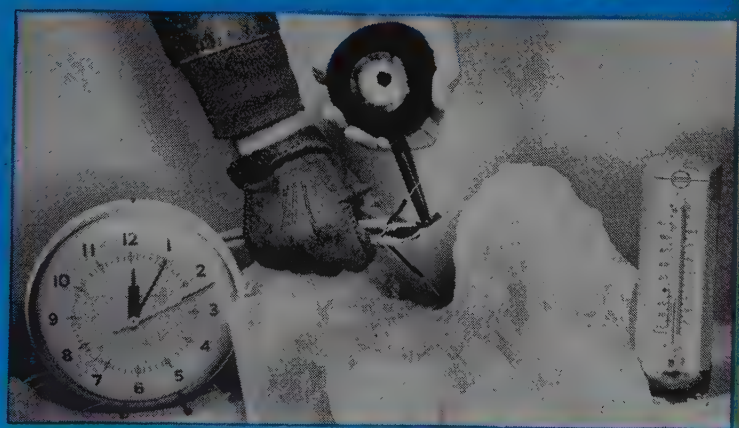
Tape is broken out of ice . . . still at 14 below . . .



and in this frigid atmosphere remains completely flexible — strips perfectly from roll — even with ice still imbedded in the core.

below zero, this remarkable vinyl tape
ps easily from the roll . . .
ains completely flexible . . .
ks down instantly — molds perfectly —
holds permanently!

your home freezer
— write for a sample roll
on your letterhead today!



35 seconds later perfectly conforming splice is made. Temperature . . . still 14° below!

NLY
U
IZED
TORS

PLYMOUTH RUBBER COMPANY, INC.

Pixilated Patents

By Mike Rivise

(Forty-ninth in a series of odd and interesting inventions in the electronics field from the files of the U. S. Patent Office.)

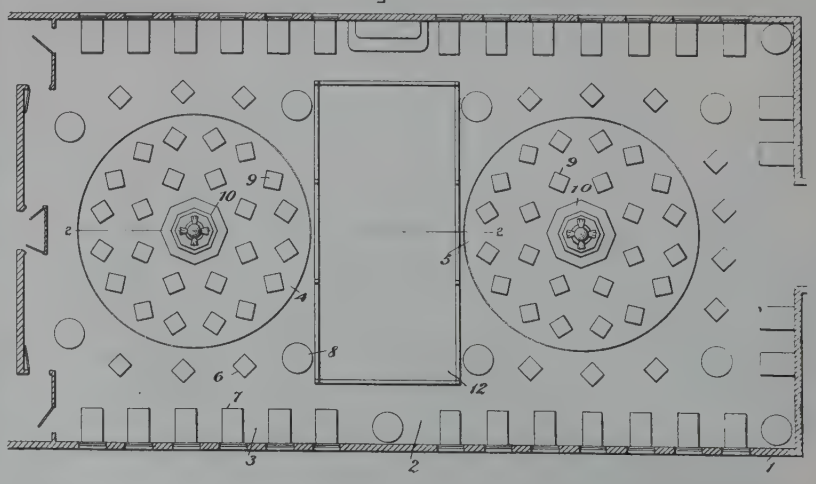
If you delight in seeing and being seen when dining out, you might like to suggest to the management of your favorite restaurant that they install a revolving dining-room floor patented by Antoine Martzolf on May 18, 1915. Such an arrangement, shown in the drawing of a top plan view, has many advantages for confirmed rubberneckers.

As explained in the patent, numeral 1 indicates a wall which does not form a part of the invention. The floor 2 is provided with a stationary part 3 and movable parts 4 and 5. Any number of these movable parts can be provided. Arranged on the stationary part 3 are tables 6 and 7 for the use of patrons, and also serving tables 8 for the use of the waiters. On the moving parts 4 and 5 are tables 9 for the patrons and serving tables 10 for the use of the waiters. Each of the serving tables 10 is provided with a dumb waiter 11 which is designed to pass from the serving table downwardly to the floor beneath where the kitchen and supplies are located.

Between the moving sections is a dancing floor 12.

The movable sections are designed to be rotated in opposite directions by a complicated set of gears driven by an electric motor. While Martzolf states that patrons will have no trouble passing onto or off the rotating sections, we suspect that he has not taken into account those who occasionally have a cocktail or two . . . too many . . . before dining. However, on the plus side, there would be little chance of being annoyed in a place with this type of floor by those signs one frequently sees in certain establishments requesting patrons to "Please remain seated while room is in motion."

Fig. 1.



Outstanding new Formvar-type wire specifically for hermetic motors using R-22 . . .

PHELPS DODGE HERMETEZE®

- Excellent resistance to softening and extraction by R-22 and R-12 refrigerants.
- Exceptional resistance to all conventional solvents.
- Outstanding ability to take heat and pressure without excessive physical softening—provides maximum protection against short time, high overload stress on windings.
- Excellent chemical stability—good resistance to hydrolysis.
- Retains flexibility in hot oil.
- Retains dielectric at operating temperature.
- No sacrifice of physical or electrical properties over hermetic Formvar.

Hermeteze is Phelps Dodge's new Vinyl Formal-Urethane magnet wire for hermetic motors operating in R-22 and R-12 refrigerant gases and oil. It represents a major advance in film wire insulation designed for hermetic unit operation. In addition to having all the excellent physical, chemical and electrical properties of Formvar, Hermeteze offers remarkably improved properties for protecting windings against failure from plastic flow at overload conditions.

Any time your problem is magnet wire, consult Phelps Dodge for the quickest, surest answer!

Formvar®-Shawinigan Resins

FIRST FOR LASTING QUALITY—FROM MINE TO MARKET!

PHELPS DODGE COPPER PRODUCTS CORPORATION

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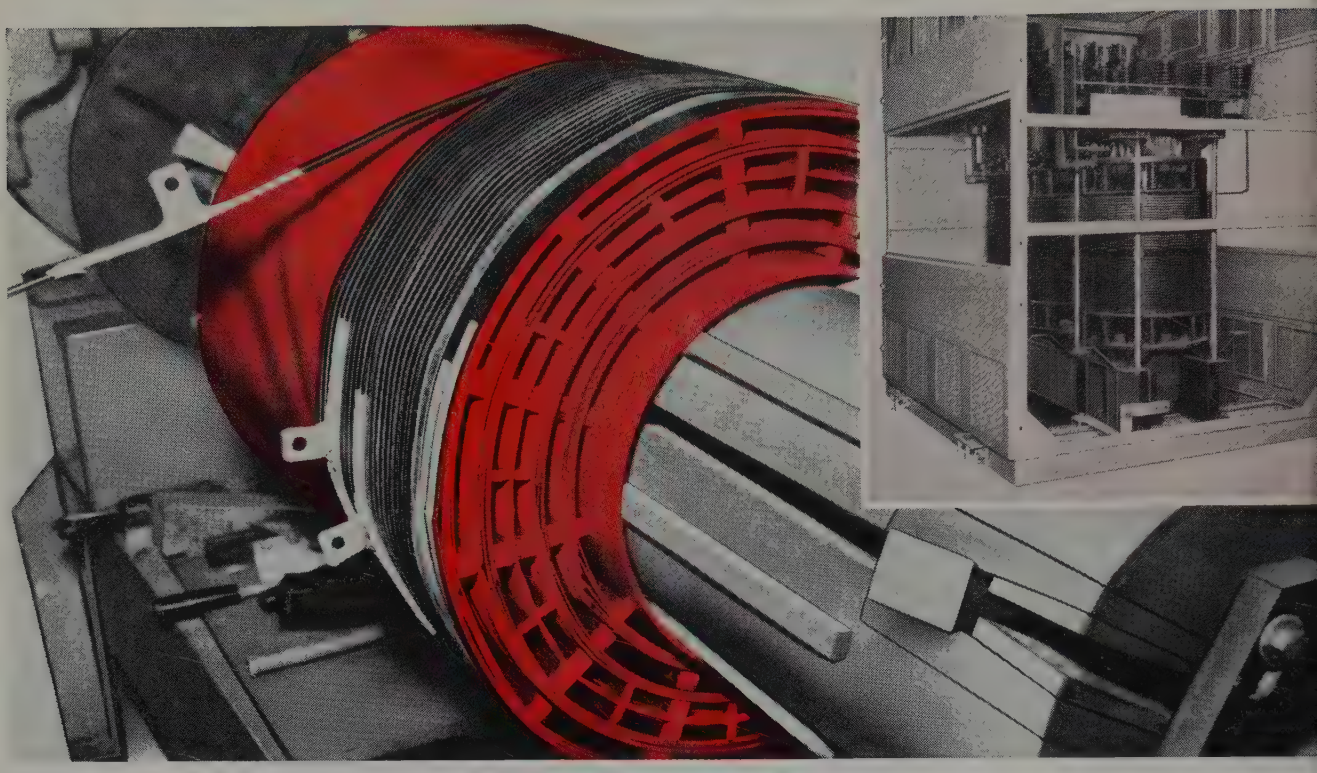

Silicone-Glass Laminates Help Make I-T-E Transformers Reliable, Trouble-Free

Insulating components made from silicone-glass laminates help improve the design and performance of electrical equipment. Bonded with heat-stable Dow Corning silicone resins, glass laminates have high arc resistance, low loss factor, low moisture absorption . . . excellent mechanical and dielectric strength even after prolonged aging at 250 C.

To assure dependable performance of their Class H unit substation transformers, the I-T-E Circuit Breaker Company specifies silicone-glass laminate for spacer strips, the insulating diaphragm between secondary and primary windings, the supporting cylinder, and for interphase barriers.

I-T-E uses this quality construction in ventilated dry-type transformers rated 112½ to 500 KVA; sealed dry-type units rated from 300 to 3000 KVA.

When used with other silicone insulating components, silicone-glass laminates permit smaller, lighter weight transformers that are easier to install and maintain than transformers using any other class of insulation.

Silicone-glass laminates are also widely used for slot wedges, coil dividers, and top sticks in motors; for terminal boards and coil forms in other electrical equipment. Silicone-glass laminates are supplied by leading laminators as tubes, sheets, punched or molded shapes. Write today for full information plus list of fabricators.

PROPERTIES OF SILICONE-GLASS LAMINATE SAMPLE

Property	Range
Flexural strength, flatwise, psi,	
Lengthwise	20,000-40,0
Crosswise	18,000-33,0
Izod impact strength, edgewise, ft-lb/in. notch	
Lengthwise	6.5-17.0
Crosswise	5.5-14.0
Bonding strength, lbs., ½-inch thickness	
Condition A†	650-110
Condition D-48/50††	550-950
Water absorption, percent	0.05
Electric strength, volts/mil	
Initial	310
After 200 hr at 260 C	327
After 5000 hr at 260 C	180
Dielectric constant at 10^2 cycles	
Condition A†	3.70
Condition D-24/23††	3.85
Dissipation Factor at 10^2 cycles	
Condition A†	0.002
Condition D-24/23††	0.008
Arc resistance, seconds	
Condition A†	180-292
Condition D-48/50††	180-248
Volume Resistivity, meg-cm.	
Condition C-96/35/90‡	1x10⁴-4x1
Surface resistivity, megohms	
Condition C-96/35/90‡	10-10,00

* As measured on samples ⅛ inch thick
† As received
†† After immersion in water (hours/deg. C.)
‡ After (hours/deg. C./% relative humidity)

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one varnish helps make motors safer, more reliable virtually maintenance-free. These are among the rea- why Automatic Transportation Company, Chicago, Dow Corning varnish and a complete silicone insula- system in the drive motors for their line of material dling equipment. These Class H drive motors . . . sub- ed to inching, frequent starting and reversing, long k cycles, heavy loading when trucks are climbing ramps have more than enough extra capability — assured by outstanding thermal stability of silicones.

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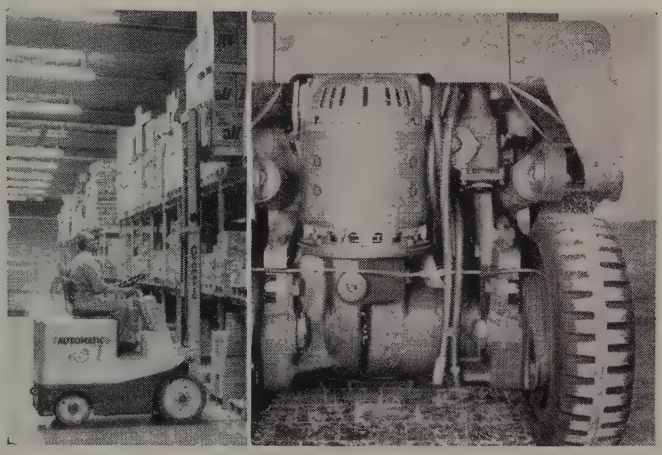

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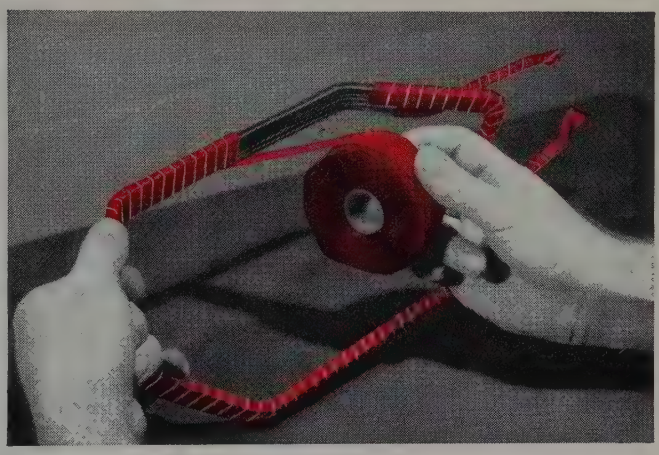

nned Pump Motor End-Turns Potted

igned for maximum reliability, Westinghouse remov- stator canned motor-pumps like this one are used for er boiler circulation in controlled circulation conven- al systems. Similar pumps are used to circulate radio- ve liquid coolants at temperatures up to 650 F in her- ically sealed primary coolant systems of nuclear re- rs. End-turns of stator coils are potted in Dow Corning entless silicone resins to insure a solid, void-free fill oil interstices. These solventless resins are radiation stant, withstand vibration, oxidation, corona and mois- despite continuous service at high temperatures.

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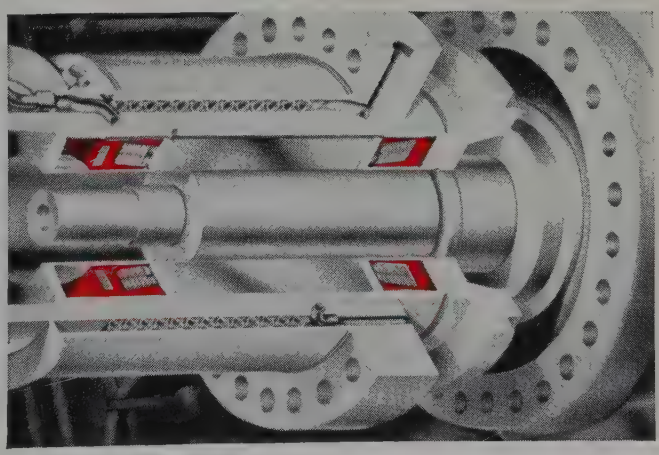

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New Developments in Epoxy Resins—Part 2

Over 75 Curing Agents Available . . .

By Dr. Henry Lee, Technical Director, and Kris Neville, Project Engineer, The Epoxylite Corp., South El Monte, Cal.

The previous article presented a listing of the 75 commercial and developmental epoxy resins available today.

This article describes the curing agents commercially available and outlines the various considerations involved in the selection of a curing agent for a given epoxy resin.

Cure of epoxy resins is said to occur when substantially all of the potentially reactive sites within the epoxy resin-curing agent have been reacted with one another and the epoxy resin has been converted from a group of discrete molecules into huge macromolecules, bonded together in all three dimensions, such that the resin will not remelt or flow upon the application of heat.

Cure of epoxy resins may be accomplished by two means: (1) catalytically, or (2) by copolymerization with molecules containing groups capable of reacting with the epoxy resins. In some cases, catalytic and copolymerizing reactions may occur simultaneously or sequentially. In other cases, secondary curing agents may be used to effect polymerization through reactive sites other than the epoxy groups present in the molecules of the system.

The number of chemical compounds capable of curing epoxy resins is phenomenal. Over 75 in common or experimental use are presented in figures 1, 2, and 3. Because each of these curing agents is a part of the final cured resin in one way or another, the curing agent is just as vital a part of the epoxy resin system as the resin itself, and the selection of a proper curing agent for a given application system involves considerable research on the part of the epoxy chemist before he is able to provide a finished, fully-developed compound.

Before proceeding further, it is useful to examine the two types of cures which are possible with epoxy resins.

Catalytic Cure

The essential feature of catalytic cure is that one epoxy resin molecule is caused to react directly with another epoxy resin molecule. This re-

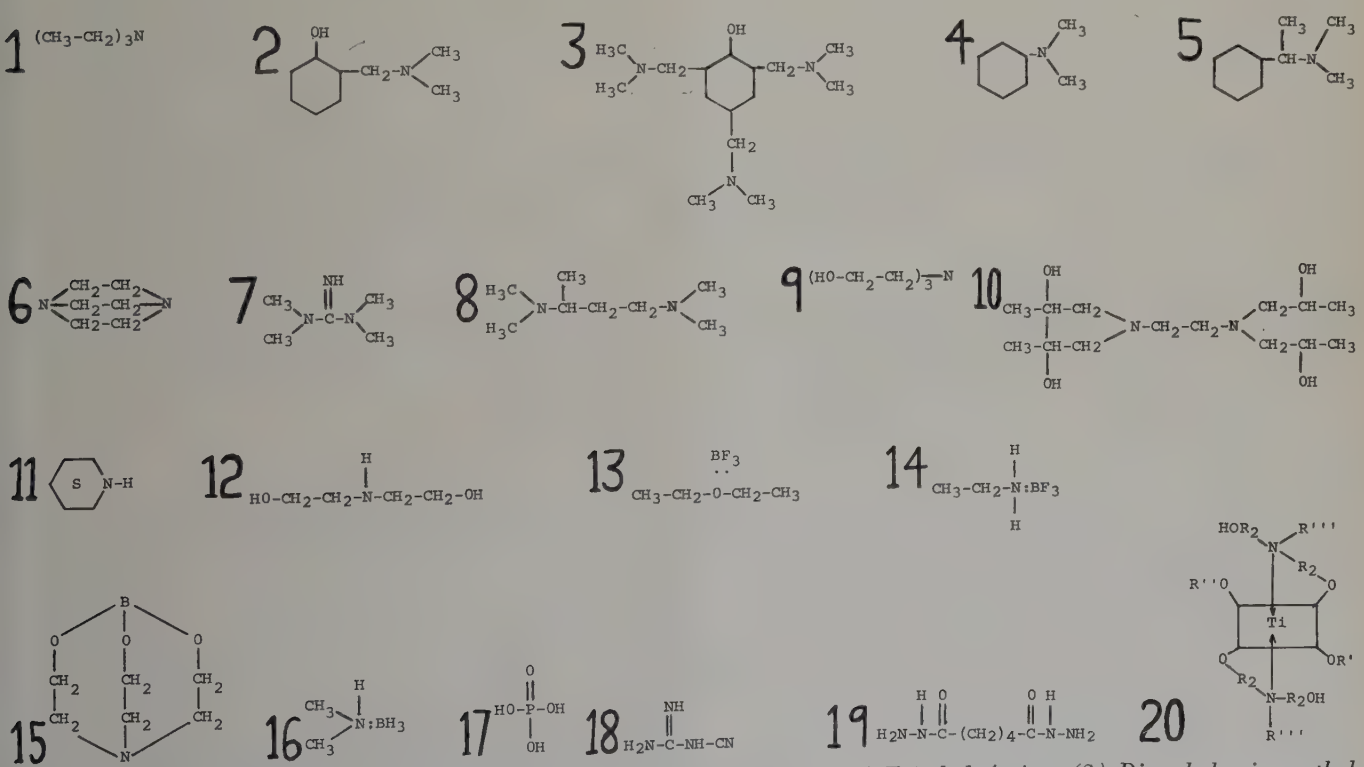


Figure 1, TYPICAL EPOXY RESIN CATALYSTS: Tertiary Amines: *(1) Triethyl Amine, (2) Dimethylaminomethyl Phenol, (3) Tris (dimethylaminomethyl) Phenol, (4) Benzyldimethylamine, (5) Alpha-Methyl Benzyldimethylamine, (6) Triethylene Diamine, (7) 1,1,3,3-Tetramethyl Guanidine, (8) n,n,n′,n′-Tetramethyl-1,3-Butane Diamine (9) Triethanol Amine, (10) Quadrol.* Mono-functional Secondary Amines: *(11) Piperidine, (12) Diethanol Amine.* Boron Complexes: *(13) BF_3 Etherate, (14) BF_3 Monoethylamine, (15) Triethanol Amine Borate (and Tri-isopropanol Amine Borate).* Boranes: *(16) Dimethyl Amine Borane.* Inorganic Acids: *(17) Phosphoric Acid.* Short Chain Amides: *(18) Represented by Dicyandiamide.* Dihydrazides: *(19) Represented by Adipyl Dihydrazide.* Titanate Esters: *(20).*

action is initiated by a catalyst and then proceeds rapidly until the epoxy groups are consumed or become end stopped by impurities.

The essential constituent of the catalytically cured structure will be the epoxy resin molecule itself. Such a system is called a homopolymerized resin and is shown in figure 4. The functionality and reactive density of the resin—together with the nature of its chemical bonds—will determine the cured properties. In this case, the chief chemical bond other than carbon-carbons are ether bonds.

Theoretically, a given epoxy resin system should cure up to give substantially the same properties irrespective of which catalyst is employed to effect cure. In practice, this is not the case, insofar as catalysts will differ in reactivity rates, and greater or lesser concentrations will be employed. Obviously, the amount of catalyst is critical. Under-catalysis provides undercure. Over-catalysis causes the system to be "degraded" from the theoretical optimum, since either the free catalyst will be locked in unreacted as a diluent, or the catalyst will have initiated polymerization at so many sites that the resin polymerization will be in effect end-stopped at a low degree of crosslinking due to the early exhaustion of unreacted resin before large crosslinked chains are built. Or steric hindrance on the part of catalyst-resin complexes may prevent complete cure.

Catalysts are usually used in concentrations ranging from 1-10 parts per 100 parts resin (phr) by weight. The reaction may, with some catalysts, be achieved at room tempera-

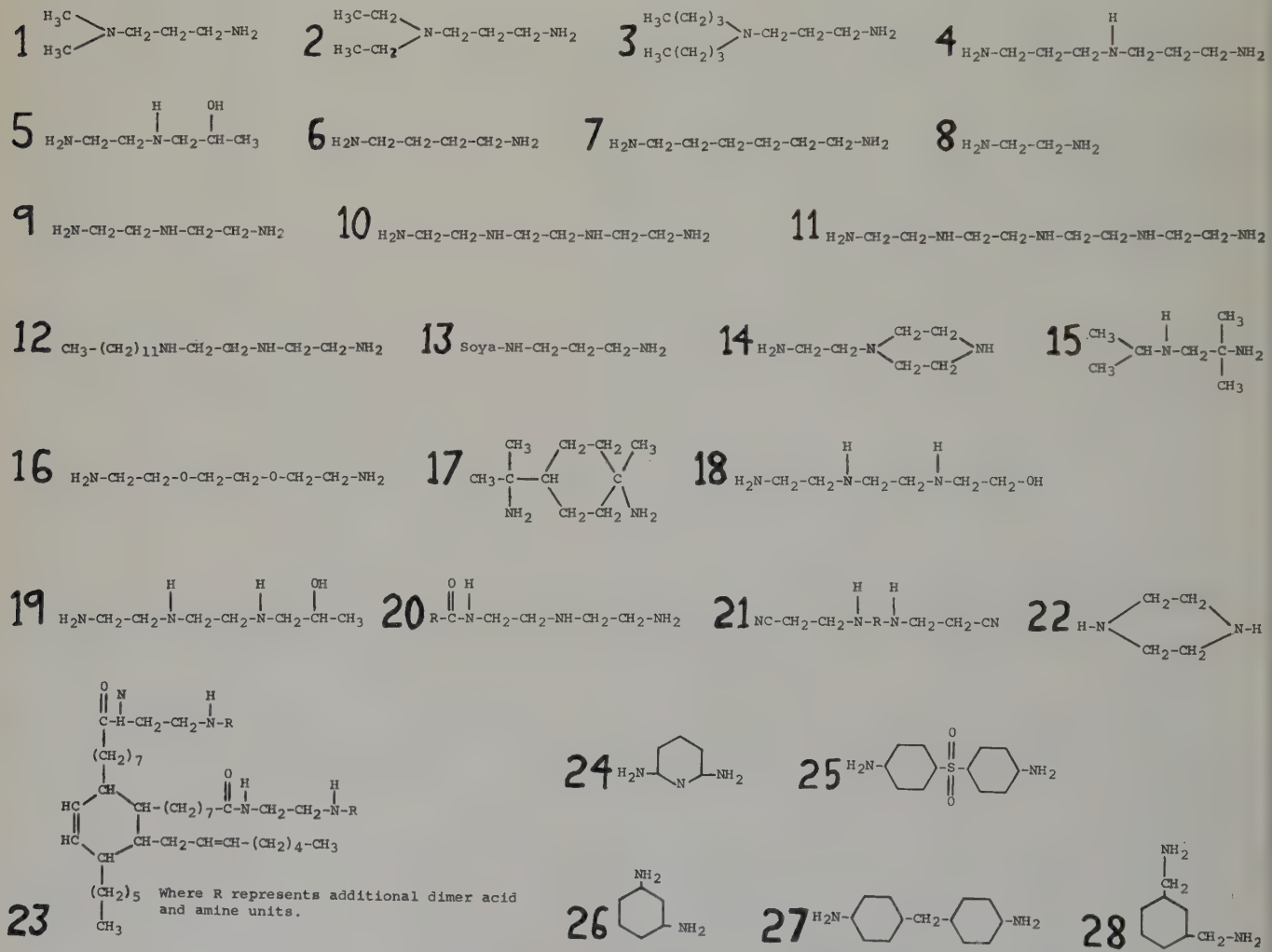


Figure 2, TYPICAL AMINE CROSSLINKING CURING AGENTS: Primary Aliphatic Polyamines: *(1) Dimethylamino Propyl Amine, (2) Diethylamino Propyl Amine, (3) Dibutylamino Propyl Amine, (4) Iminobis Propyl Amine, (5) Monolene, (6) Tetramethylene Diamine, (7) Hexamethylene Diamine, (8) Ethylene Diamine, (9) Diethylene Triamine, (10) Triethylene Tetramine, (11) Tetraethylene Pentamine, (12) Dodecyl Polyamine (13) Duomeen S, (14) Amino Ethyl Piperazine, (15) n'-Isopropyl-2-Methyl-1,2-Propane Diamine, (16) Amine-capped Glycols, (17) Menthane Diamine.* Amine Adducts: *(18) Ethylene Oxide Adduct of DETA, (19) Propylene Oxide Adduct of DETA.* Amine-containing Amides: *(20) Mono-amides.* Secondary Aliphatic Polyamines: *(21) Cyanoethylation Adducts, (22) Piperazine, (23) Polyamides.* Primary Aromatic Amines: *(24) Diamine Pyridine, (25) Diaminodiphenyl Sulfone, (26) Metaphenylene Diamine, (27)' 4,4'-Methylene Dianiline, (28) Metaxylene D iamine.*

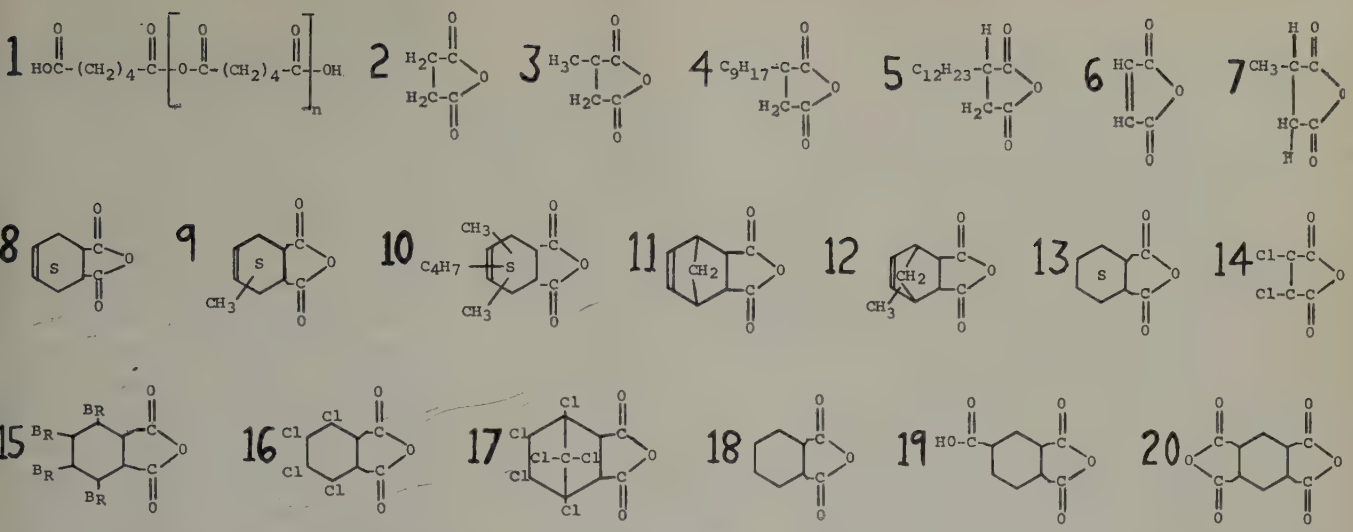


Figure 3, TYPICAL ANHYDRIDE CURING AGENTS: Aliphatic Anhydrides: *(1) Adipic Anhydride (Polymeric), (2) Succinic Anhydride, (3) Methyl Succinic Anhydride, (4) Nonenyl Succinic Anhydride, (5) Dodecenyl Succinic Anhydride, (6) Maleic Anhydride, (7) Citraconic Anhydride (Methyl Maleic Anhydride), (8) Tetrahydro Phthalic Anhydride, (9) Methyl Tetrahydro Phthalic Anhydride, (10) Dimethyl Butenyl Tetrahydro Phthalic Anhydride, (11) Endo-cis-bicyclo(2.2.1)-5-heptene-2,3-dicarboxylic Anhydride, (12) Methylbicyclo(2.2.1)heptene-2,3-dicarboxylic Anhydride, (13) Hexahydrophthalic Anhydride.* Halogenated Anhydrides: *(14) Dichloro Maleic Anhydride, (5) Tetrabromo Phthalic Anhydride, (16) Tetrachloro Phthalic Anhydride, (17) Chlorendic Anhydride.* Aromatic Anhydrides: *(18) Phthalic Anhydride, (19) Trimellitic Anhydride.* Dianhydrides: *(20) Pyromellitic Dianhydride.*

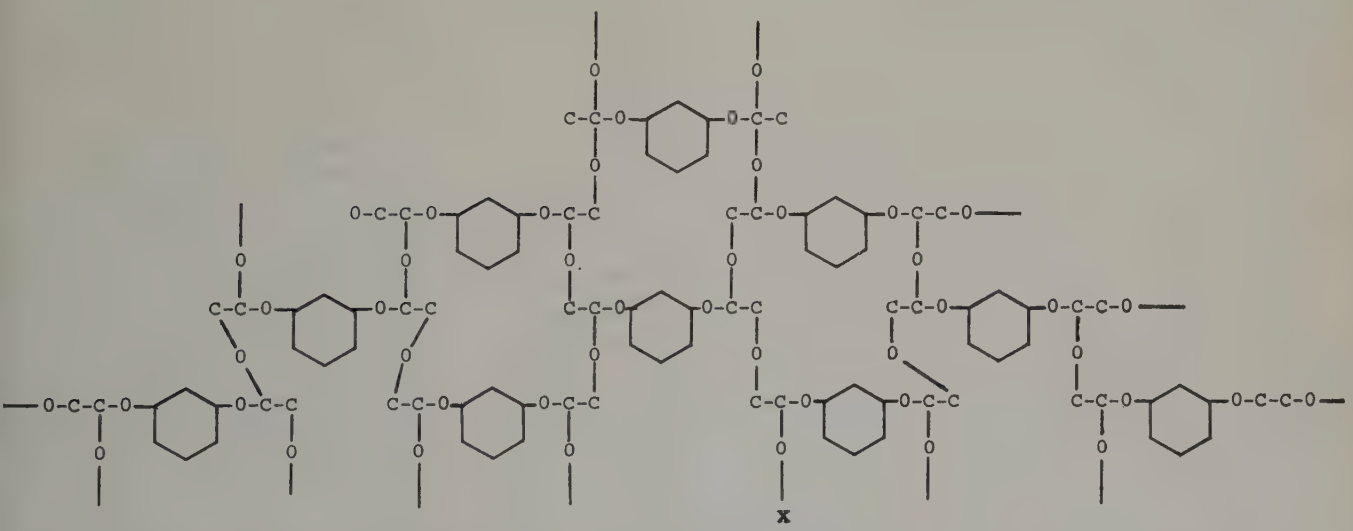


Figure 4, schematic diagram of a simplified epoxy resin cured catalytically (homopolymerization). Hydrogen atoms have been omitted for the sake of clarity. X is the possible site of the catalyst which initiated the polymerization of some of the molecules shown. Theoretical calculations indicate each catalyst molecule can catalyze or initiate a chain of polymerization of 10-30 molecules of resin. The cured resin is characterized mainly by the high percentage of C-O-C (ether) bonds.

ture; whereas with others, a heat cure may be required.

The amount of catalyst used is usually dictated by the reaction time desired; and all other things being equal, the lesser amount is to be preferred to the greater amount.

Typical of the catalysts used as primary curing agents—as distinct from accelerators (discussed below) —are those illustrated in figure 1.

Crosslinking Agents

To distinguish the crosslinking agents from the catalysts: the crosslinking agents react with the epoxy molecules and are coupled directly into the cured system as structural members of the molecular network. They become a vital part of the cured resin chain, and their properties affect final properties in proportion to their type and the percentages present to a greater extent than in homopolymer-

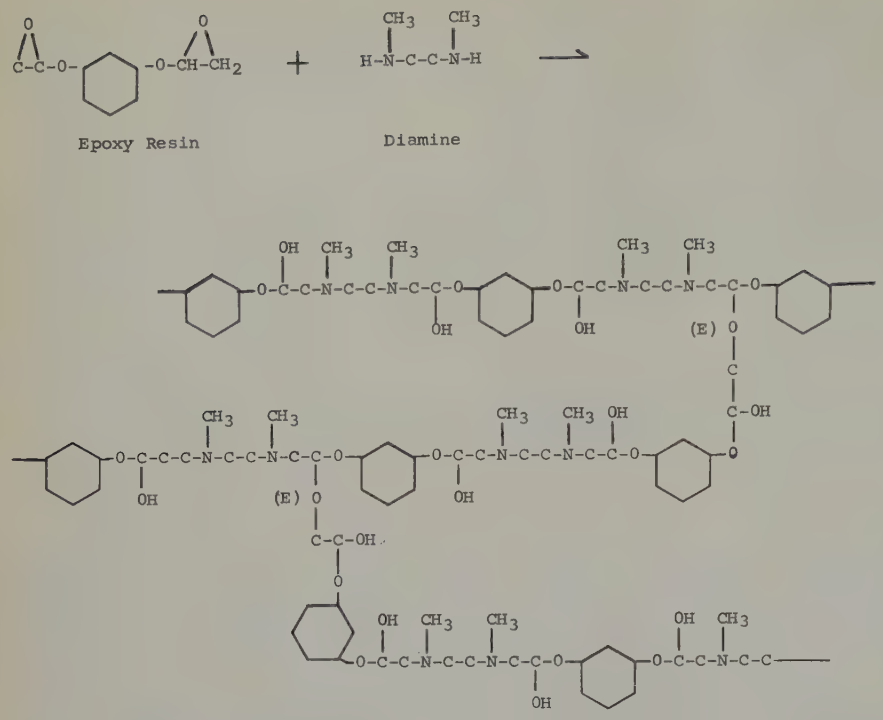


Figure 5, schematic diagram of an epoxy resin cured with a difunctional diamine as an example of amine-epoxy heteropolymerization. Note occasional ether linkages denoted by (E) which provide crosslinking of linear chains formed by polymerization of epoxy and amine. Using amines of higher functionality provides crosslinking directly by heteropolymerization, with carbon-nitrogen bonds being predominant, but some ether linkages are almost always formed.

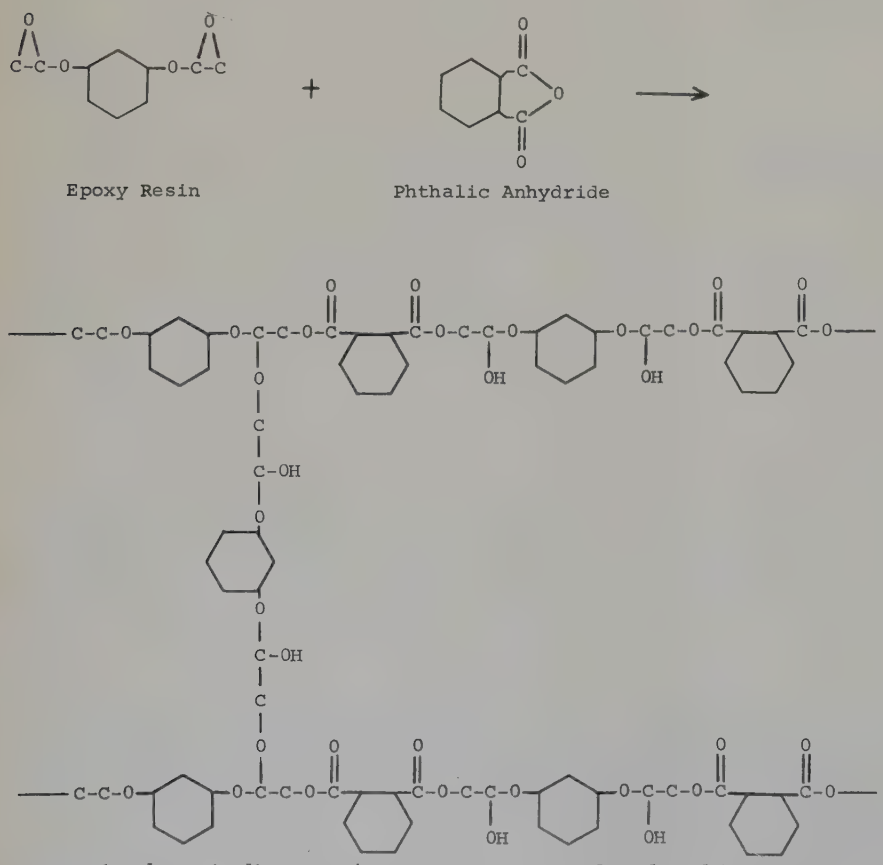


Figure 6, schematic diagram of an epoxy resin cured with a difunctional acid anhydride as an example of an anhydride-epoxy heteropolymerization. The chief bond formed is an ester bond. Note one epoxy molecule is shown (ideally) as having crosslinked two epoxy-anhydride chains, and producing ether linkages.

ized resins.

The crosslinking agents contain sites or radicals which are reactive with the epoxy groups in the epoxy resin. The crosslinking agents are provided in an amount intended to assure the consumption of epoxy groups. In many cases, the amount will be such that one reactive group of the curing agent is provided for each epoxy group in the system. In other cases, competing reactions will dictate the use of amounts somewhat below or over the 1:1 stoichiometric ratio. In any case, there is an optimum amount of curing agent which will assure substantially complete reaction and amounts above or below this will result in some reduction of cured properties.

It follows, then, that crosslinking agents may be present in substantial quantities (from 10-100 phr or more) and the properties of the cured system will be influenced by the specific curing agent employed.

Resins cured by crosslinking agents are referred to as heteropolymerized resins and are illustrated in figures 5 and 6.

Accelerators for Curing Agents

Some curing agents require the presence of other catalysts or accelerators to produce a convenient rate of reaction. The accelerators may be either catalysts or non-curing reagents. Because they directly affect the reaction mechanisms, many accelerators, although used in trace amounts, will produce gross changes in the physical properties of the cured system as compared to the properties of the unaccelerated system with the same crosslinking agent. This is particularly true in the case of cure with anhydrides, where the amount of curing agent employed will depend upon the presence or absence of an accelerator.

Selection of Curing Agent

The selection of curing agents for epoxy resins involves a study of the properties desired in the end product together with the properties of the resin. Thus, for a given epoxy resin, the concepts of functionality, crosslink density, chain length between

crosslinking points, dipole moment, polarizability, etc., all are of importance and must be considered, just as in the case of the epoxy resin itself.

For example, let's review the problem of producing a resin with (1) high heat stability, (2) high strength at elevated temperatures, (3) high chemical resistance, and (4) good mechanical toughness. High heat stability means predominantly ester linkages in the cured resin, implying anhydride curing agents. High temperature rigidity implies the highest functionality and highest crosslinking density curing agent and resin. High chemical resistance implies that the ester linkage, needed for heat stability, be protected from hydrolysis by caustics by one of two means: (1) either select a resin or curing agent with a methyl or ethyl or other group near the potential ester linkage, so as to provide steric hindrance to caustic attacking the bond, or (2) provide, by proper choice of accelerators, a cure mechanism which will afford a percentage of alkali-resistant ether linkages, so that alkali penetration is restrained to surface attack only.

Examination of figure 3 of this article and figures 1 and 2 of the first article of this series on epoxy resins, shows that a number of resins and curing agents fit these possibilities. These then must be reviewed as to handling properties, i.e., viscosities of mix, pot life, gel time, cure requirements, etc., to select the combination best suited for the application. Of course, despite full application of theoretical principles and empirical rules of thumb in formulation, the final compound must be evaluated by conventional test methods and by evaluation in prototypes of the final application.

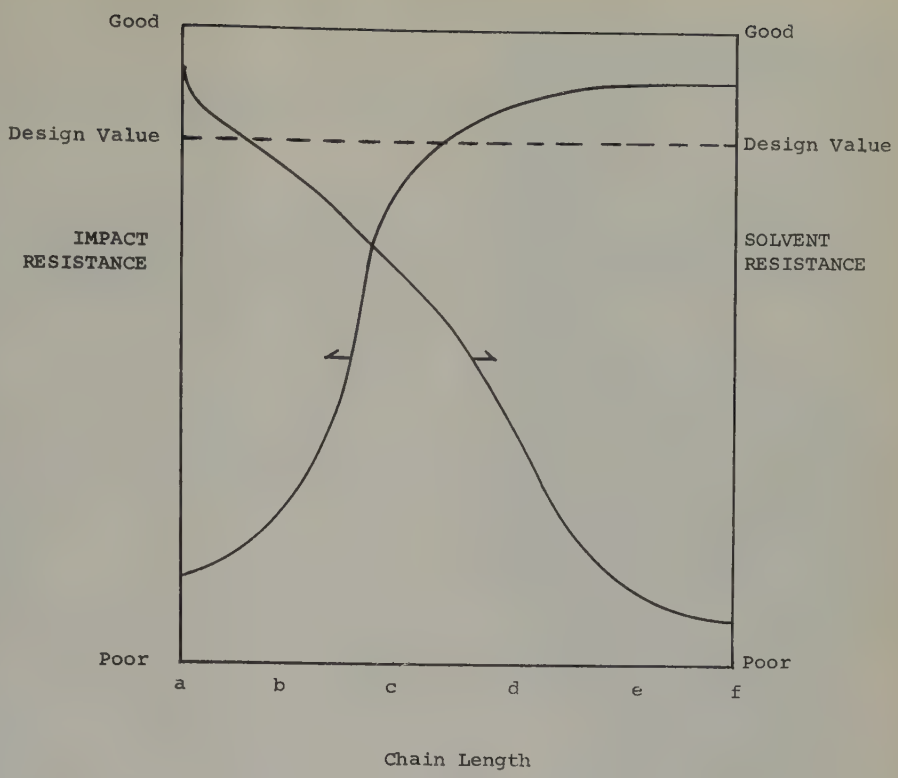


Figure 7, impact resistance and solvent resistance as a function of curing agent chain length. This shows that for a certain resin and a given family of curing agents, only one property at a time will meet the design value, that even an optimum balance of chain length will not suffice due to the principle of mutually exclusive properties. To meet the design value for both properties simultaneously, a different resin or curing agent family must be used.

Other Ingredients

In addition to the epoxy resin-curing agent combination, there are also numerous other ingredients which may be used in epoxy formulations. These range from rubberizing plasticizers to metallic fillers, and offer a wide range of formulation possibilities for a given application. A great deal of progress has been made in this area in the past five years to make epoxy resins more thermal shock resistant, lower in viscosity, more heat stable, more chemically resistant, lower in cost, and still more versatile. These other ingredients, which are generally not reported in the literature because of the great expense in developing them and because of their proprietary nature, in combination with the vast array of epoxy resin molecules now available, make the range of properties which epoxy resins may now be formulated to meet almost unbelievable compared to 10 years ago. The next article in this series outlines typical properties involved in a major electrical encapsulation problem and shows how these were achieved.

To tabulate or quote a range of values at this point as being representative of epoxy resins would be misleading, because of the principle of mutually exclusive properties.

Mutually Exclusive Properties

By mutually exclusive properties is meant properties which work against each other; that is, to get good values of one property, one must sacrifice or compromise another property. An example would be mechanical impact resistance vs solvent resistance. Mechanical impact resistance implies loosely coiled resin chains which are capable of flowing past each other or distorting when subjected to a sharp impact. Solvent resistance implies a certain polarity in the chemical chains composition as well as tightly crosslinked, non-mobile chains.

An example will serve to illustrate this point. Resin (A) when cured with curing agent (a), the shortest chain member of a series (say for, example, the series ethylene diamine, propylene diamine, hexylene diamine, etc., or the series succinic anhydride, methyl succinic anhydride, nonenyl succinic anyhdride and dodecenyl succinic anhydride) has adequate solvent resistance. See figure 7. However, it has too low an impact resistance. See figure 7. When cured with curing agent (f) it has adequate impact

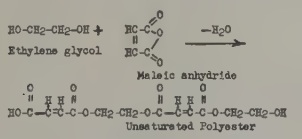
Polyester Versus Epoxy Resins

One point concerning epoxy resins which needs clarification is the frequently asked question of *why are epoxy encapsulating resins better than polyester resins?*

It is not sufficient merely to say that epoxy encapsulating resins have better all-around properties, pound-for-pound and dollar-for-dollar, than polyester resins, because there will still be disbelievers due to the very excellent properties of polyesters, such as "Mylar" film and polyester magnet wire.

What needs clarification is that there are two types of polyesters. Type I are called "unsaturated" polyesters; type II are called the "saturated" polyesters.

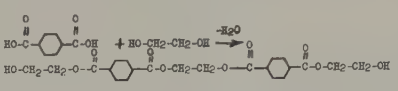
The type I unsaturated polyester resins are based on materials such as ethylene glycol and maleic anhydride



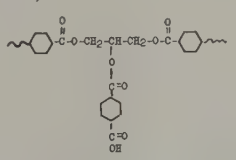
These are light colored, low viscosity liquids and will crosslink through the olefin or unsaturated double bonds (—C=C—) in the presence of a peroxide, though usually styrene monomer is used to provide more positive crosslinking.

These unsaturated polyester resins find their big use in glass laminate manufacture (boats, fishing rods, etc.), but, as electrical grade encapsulating resins, they have the drawbacks of high shrinkage, low heat stability, low thermal shock resistance, and limited chemical resistance.

The type II saturated polyester resins are based on materials such as terephthalic acid and ethylene glycol and glycerol. In practice the methyl ester of the acid is usually used for processing convenience, but schematically the reaction proceeds



The use of a small percentage of glycerol provides side chains along the resin chain,



thereby increasing the functionality and hence the crosslinkage density of the polyester.

These saturaterd polyesters are not liquids. Even in their lower molecular weight forms they are solids. Hence, they can only be handled effectively from solvent solution. This is satisfactory for casting films such as Mylar, or for making fibers such as "Dacron," and for varnish coating copper magnet wire, but they cannot be used as casting resins due to the solvent problem and the need to continue to remove water as the polyester condensation reaction is driven to completion.

A fully cured saturated polyester resin could be represented as shown in figure 8. The similarity of this with an anhydride cured epoxy, figure 6, is obvious. The formation of ester linkages when an epoxy reacts with the carboxyl group of an organic acid or acid anhydride makes the epoxy-anhydride system, in effect, a low viscosity liquid, heat curable, saturated polyester. Hence, epoxy resins are really but a route to the "in situ" polymerization of saturated polyesters. The properties of the resin will depend greatly on the actual resin and anhydride used, just as the properties of polyester magnet wire enamels vary greatly depending on the ingredients used, as will be discussed further in a subsequent article on the chemistry of modern magnet wire. Whether the product is described as an epoxy resin or as a saturated polyester derived from an epoxy-resin is immaterial. It merely exemplifies the underlying versatile chemical nature of epoxy resins and the fact that they will continue to grow in importance in their role in the electrical industry, under no-matter-what name.

strength but inferior solvent resistance. By curing resin (A) with curing agent (b), or (c), or other intermediate curing agents, the impact resistance is improved over that of (a) as shown in figure 7, but the solvent resistance is degraded.

At a chain length (c) the properties are at about an optimum; that is, the maximum increase in mechanical shock resistance has been achieved for the least loss of chemical resistance. However, at this point, neither the impact strength or solvent resistance meets the design specifications. Hence, although this resin-curing agent system will meet any *one* of the properties, it cannot meet *two* or more because of the principle of mutually exclusive properties. Restated, a given resin and a given series of curing agents may, as a class, because of mutually exclusive principles, be incapable of meeting a particular requirement. Another class (of resin and curing agent) may meet the requirements when the proper balance of polarity, chain length, crosslinking density, is met. Often, only the experienced epoxy chemist, combining theory with practical competitive formulation know-how, can determine this economically.

Hence, any values reported as a range of values must be interpreted as a range for that one property only. To try to obtain a compound with the best value of *all* the properties in such a list may be not feasible technically or may be uneconomical. An experienced formulator can save weeks of time of going down blind alleys on a given application because of his familiarity with the principle of mutually exclusive properties and his wide experience with all epoxy resin types and curing agent types.

Latent Curing Agents

One type of curing agent which continues to receive considerable interest are those which are described as "latent" curing agents. These curing agents, when incorporated into epoxy resins, provide systems with long pot life (3-6 months) at room temperature, but which cure at elevated temperatures.

Most of these systems are of five

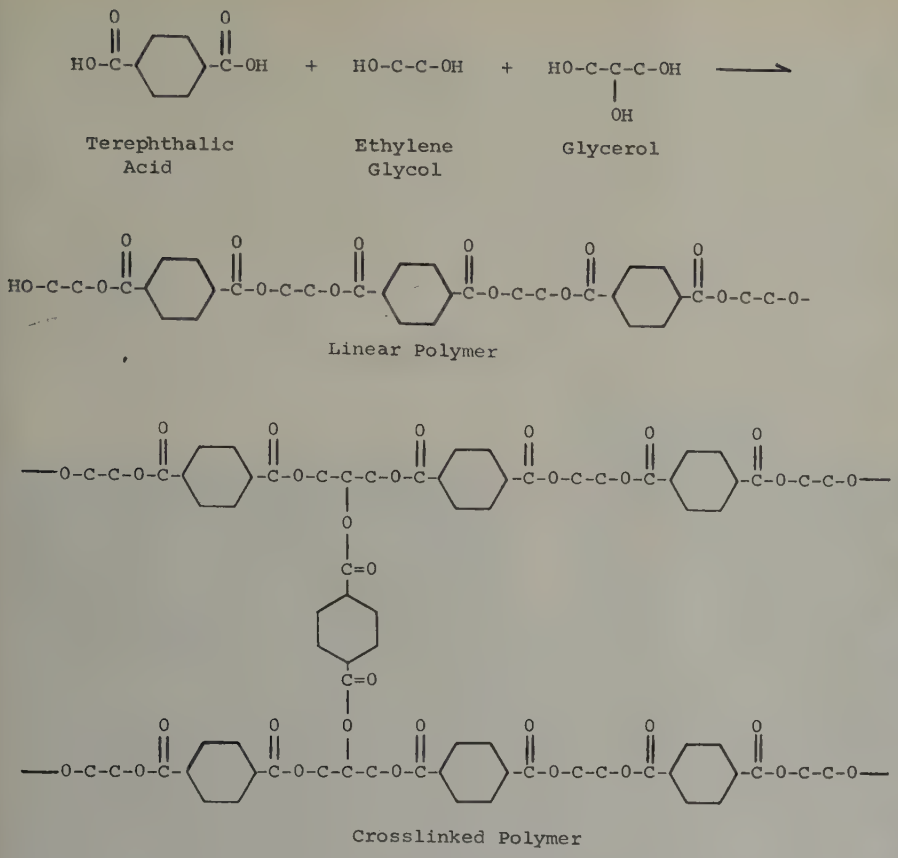


Figure 8, schematic diagram of a saturated polyester resin such as used on magnet wire. Control of ratio of ethylene glycol to glycerol determines whether a high molecular weight linear polymer will be formed, or if occasional cross-linking of chain is permitted due to the third hydroxyl group on glycerol. Comparison with figure 6 shows that the epoxy-anhydride system is also, nomenclature-wise, a saturated polyester.

types: (1) boron trifluoride–amine complexes, (2) boroesters, (3) dialkylolamine titanates, (4) adipyl dihydrazides, and (5) molecular sieves.

The materials are used to some advantage in some applications, but generally the formulas are limited in scope. The attainment of a single container system often entails sacrifice of some formulation possibilities, so that single container epoxy-curing agent systems usually do not possess as good a set of properties as the two container systems. It is for this reason alone that the authors rarely formulate on this basis. Other disadvantageous properties which many of the single container systems reveal are: high curing temperatures or long cure time, incompatibility with magnet wire, poor heat stability (incongruously, ether polymerization catalysts are also ether depolymerization catalysts at temperatures slightly higher than cure temperatures), and high cost.

Molecular Sieves

One new latent type curing agent which is being explored is amine-loaded molecular sieves. Molecular sieves are synthetic zeolite crystals having internal cavities with entrance apertures of carefully controlled size, about 5 to 10 Angstroms. By proper technique, it is possible to permit an amine to penetrate the cavities of a sieve and to be absorbed on the inner wall of the sieve. The sieve may then be compounded into an epoxy resin to provide a considerable degree of latency. Subsequently, when the resin is heated, the amine escapes from the sieve and proceeds to accelerate the cure of the epoxy resin.

This is but one of the numerous techniques of formulation know-how which the epoxy chemist must explore if he is to keep his company's products in the forefront of the technology.

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Diallyl Phthalate Resin Varnishes For Dip Encapsulation

By James Thomas, Plastics Engineer, Applications Technical Service Laboratory, Food Machinery and Chemical Corp.

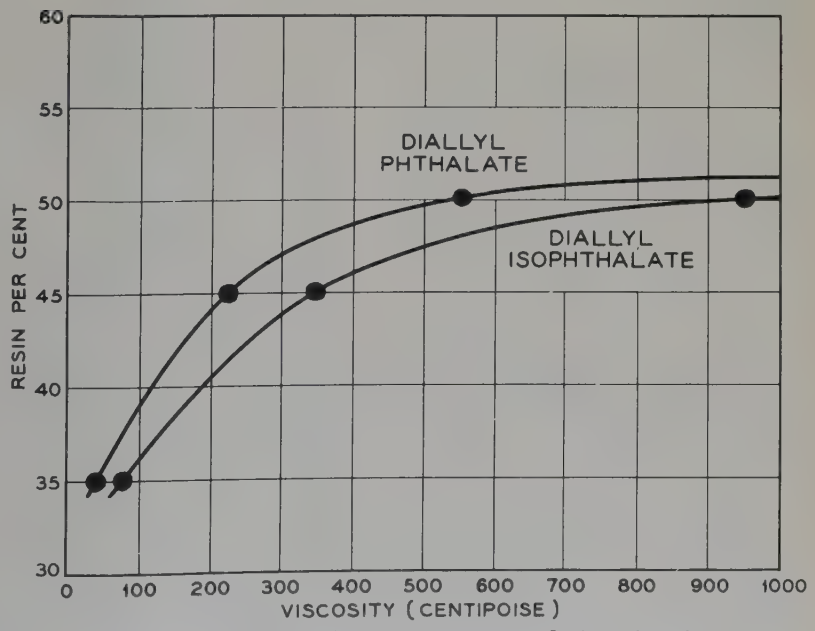
Cured diallyl phthalate resins are widely used in the electrical and electronics equipment industry because of their unique insulation and dimensional stability properties. Their generally excellent electrical characteristics have made them particularly desirable as molding materials for electronic parts. They have been found to maintain their properties in extremely adverse environments such as high humidity and temperature conditioning.

In studies just completed it has been determined that solvent solutions utilizing diallyl phthalate also can offer these same properties. This development makes it possible to take advantage of diallyl phthalate's important insulation and electrical benefits in coating, sealing, dip encapsulating, and laminating applications.

After curing, coatings of these materials possess excellent resistance to moisture, chemicals, corrosive gases, fungus, weathering, and aging over a wide temperature range. They can be recommended for protective coatings on capacitors, resistors, transformers, form-wound coils, motor windings, transistors, diodes, and other uses. A coating can be applied by dipping the particular part in a diallyl phthalate solvent solution, drying, and baking

Table I—Resin Content vs. Viscosity

% Resin	Viscosity (centipoise) diallyl phthalate	diallyl isophthalate
50	550	950
45	225	350
35	40	75



Graph shows effect of resin content on solution viscosity.

Table II—Typical Properties of Unfilled Diallyl Phthalate and Diallyl Isophthalate Resins

Property by ASTM Procedures	Diallyl Phthalate	Diallyl Isophthalate
Dielectric Constant		
25°C & 60 cycles	3.6	3.5
25°C & 10^3 cycles	3.6	3.3
25°C & 10^6 cycles	3.4	3.2
25°C & 10,000 megacycles	—	3.0
200°C & 10,000 megacycles	—	3.1
Dissipation Factor		
25°C & 60 cycles	.010	.008
25°C & 10^3 cycles	.009	.008
25°C & 10^6 cycles	.011	.009
25°C & 10,000 megacycles	—	.014
200°C & 10,000 megacycles	—	.031
Volume Resistivity, ohm-cm at 25°C	1.8×10^{16}	3.9×10^{17}
Volume Resistivity, ohm-cm at 25°C (wet)(2)	$1.0 \times 10^{14+}$	—
Surface Resistivity, ohms at 25°C	9.7×10^{15}	8.4×10^{12}
Surface Resistivity, ohms at 25°C (wet)(2)	$4.0 \times 10^{13+}$	—
Dielectric Strength, vpm at 25°C(3)	450	422
Arc Resistance, secs.	118	123-128
Moisture absorption, %—24 hrs at 25°C	.09	0.1
Tensile Strength, psi	3,000-4,000	4,000-4,500
Rockwell Hardness (M)	114-116	119-121
Barcol Hardness	43	52
Specific Gravity	1.270	1.264
Izod Impact, ft lbs/in notch	0.2-0.3	0.2-0.3
Heat Distortion Temp., °C at 264 psi	155(310°F)	238(1) (460°F)
Heat Distortion Temp., °C at 546 psi	125(257°F)	184-211 (364-412°F)
Compressive Strength, psi	22,000-23,000	21,200-24,000
Flexural Strength, psi	7,000-9,000	7,400-8,300
Refractive Index at 25°C	1.571	1.569
Modulus of Elasticity in Flexure, psi	0.6×10^6	0.5×10^6
Chemical Resistance		
% Gain in Wgt. After One Month Immersion at 25°C in		
Water	0.9	0.8
Acetone	1.3	−0.03
1% NaOH	0.7	0.7
10% NaOH	0.5	0.6
3% H_2SO_4	0.8	0.7
30% H_2SO_4	0.4	0.4
Heat Resistant Properties (4)		
Wgt. Loss After Aging 6 Weeks at 177°C, %	7.6	1.2
Dielectric Constant After Aging 6 Weeks at 177°C, 60 cycles—25°C.	3.7	3.6
Dissipation Factor After Aging 6 Weeks at 177°C, 60 cycles—25°C.	.01	.006
Volume Resistivity After Aging 6 Weeks at 177°C, ohm-cm—25°C.	2.7×10^{15}	7.1×10^{15}
Surface Resistivity After Aging 6 Weeks at 177°C, ohms—25°C.	1.4×10^{13}	1.1×10^{14}
Flexural Strength, psi at 260°C, Glass Cloth Laminate(5)	—	15,400

(1) No deflection.
(2) Tested in humidity chamber after 30 days at 70°C (158°F) and 100% relative humidity.
(3) Step-by-step.
(4) 50% silica filled.
(5) 12-ply, 18 glass cloth laminate. Resin=40%.

for cure. Solvents for diallyl phthalate resins are listed in table III. None of these solvents will affect the resins after cure.

Resin Cures, Application, and Processing

Two resins of the diallyl phthalate family are available commercially. One is the prepolymer of diallyl phthalate,* which—after curing—will function under continuous operating temperatures of 150°C (302°F). The other, the prepolymer of diallyl isophthalate,** provides higher heat-resistant properties for class H, 180°C (355°F) operating conditions. The resins are converted to three-dimensional cured materials by the application of heat. Peroxide catalysts are generally used for cure although non-catalytic cures with diallyl isophthalate have been effected in 15 minutes at 246°C (475°F).

The following has been found to be a typical diallyl phthalate solution (approximately 45% solids):

Diallyl Isophthalate_____100 parts
Methyl Isobutyl Ketone__114 parts
n-Butyl Acetate_____ 6 parts
t-Butyl Perbenzoate _____ 5 parts

This solution—after drying and curing—will give a 2.5-mil coating on one dip. Since solvent evaporation is very fast and uncured diallyl phthalate coatings are dry after the solvent is driven off, very low run-off or dripping is obtained in most dipping applications. This characteristic could provide some advantages over materials that remain liquid during the cure or are thermoplastic and tend to droop during fusion.

The resin coating thickness during the dipping operation can be adjusted by altering the solvent ratio. The viscosity of solutions varies with resin content as indicated in table I. The solvent used is 95 parts methyl isobutyl ketone and 5 parts n-butyl acetate.

When coating in a one to three-mil thickness range, pre-drying for about 10 minutes at 32°C (90°F) will remove the solvent to such a level that constant coatings are obtained after

*"Dapon" 35, registered trademark of Food Machinery and Chemical Corp.
**Dapon M.

cure. Fast drying cycles at elevated temperatures are possible but temperatures above 60°C (140°F) immediately after dipping should be avoided because of possible entrapment of volatile bubbles in the drying resin.

In some applications tacky coatings may be desirable, and they are obtained by adding the respective diallyl phthalate or diallyl isophthalate monomers. For example, a diallyl isophthalate coating of 90 parts prepolymer and 10 parts monomer is slightly tacky to the touch. The addition of monomers, however, has been found to lengthen the cure time for thin film coatings.

Catalysts and Cure Time

Where cure rate is of prime importance, five parts tertiary butyl perbenzoate will give good hard cures at 160°C (320°F) in 15 minutes in the presence of oxygen. When the part being coated is temperature sensitive, temperatures as low as 100°C (212°F) can be employed provided the time is extended to 16 hours. The time necessary to reach full room temperature strength varies inversely with the cure temperature.

Reinforcing Agents and Fillers

Inert fillers such as clays, calcium carbonates, and silicas can be employed as extenders in these coatings. In general, fillers that have a pH close to neutral do not inhibit cure. Where high filler loadings are used, some diluent effect may be apparent with the result that longer cure times are necessary.

In addition, the resins can be combined with solvent to prepare laminating varnishes for use in the pre-impregnation of paper, glass cord, cloth, and tapes. The resin in the solution is non-volatile and on drying will form a tack-free or, if desired, slightly tacky material.

Unfilled cured diallyl phthalate resins have properties as indicated in table II.

Table III—Properties of Uncured Diallyl Phthalate Resins

Property	Diallyl Phthalate	Diallyl Isophthalate
Appearance	Dry, White, free-flowing powder	
Active Ingredient, %	99-100	99-100
Specific Gravity	1.259	1.256
Bulk Density, lbs/cu ft	20	23
Shrinkage on Cure, %	Less than 1.0	Less than 1.0
Softening Range, °C	80-105	55-95
Iodine No.	55	64
Solubility	Both resins readily soluble in benzene, acetone, methyl isobutyl ketone, methyl ethyl ketone, dioxane, ethyl acetate, butyl acetate, chloroform and ethylene dichloride. Insoluble in lower aliphatic hydrocarbons.	

Figure 1, a carbon resistor is dipped into a diallyl phthalate resin solution that has a viscosity of approximately 225 centipoises. The coating reportedly is uniform and will dry rapidly with minimum "stringing."

Figure 2, after the solvent has evaporated, the dry coating may be handled. Note the absence of large resin concentration.

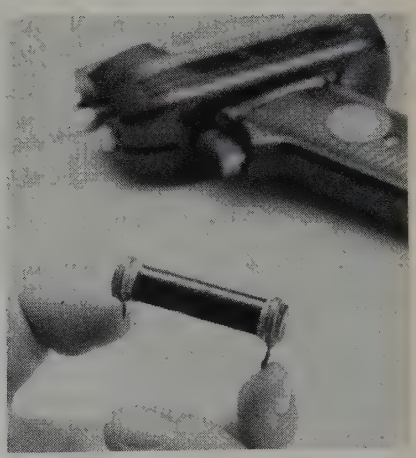
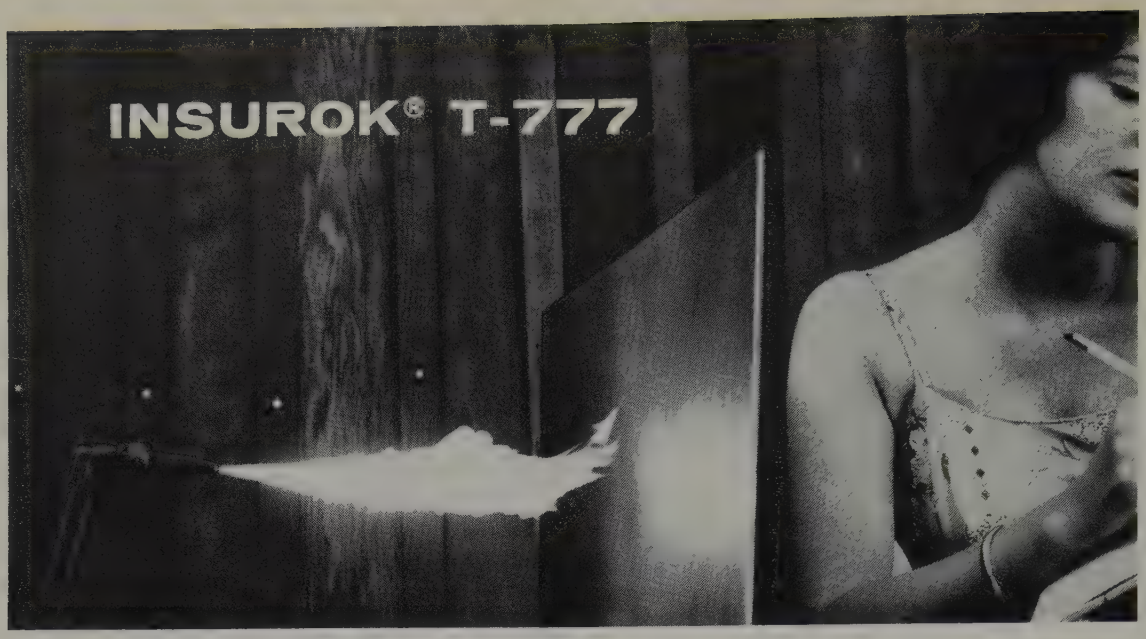


Figure 3, after curing at 320°F for 15 minutes, the coating is said to be hard, resistant to chemicals, and to possess very high electrical properties. It will withstand the heats required for soldering.



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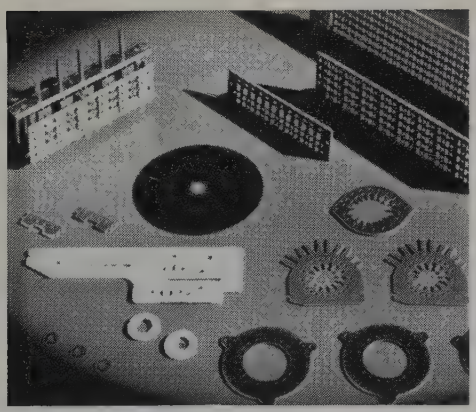

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Laminated Fabricated and Molded Plastics

Cement-Coated Epoxy . . . A New Self-Bonding Magnet Wire

By E. H. Olson, Technical Director, and R. P. Arndt, Chief Chemist, Anaconda Wire & Cable Co.

The advantages in the use of self-bonding magnet wires have been well recognized by the electrical industry. This wire has been used in producing self-supported coils such as television yoke coils, clutch coils, field coils, encapsulated coils, and numerous specialty applications.

However, in spite of the many technological advances made in the last few years in the wire insulation field, the basic self-bonding magnet wire insulation has remained the same. This insulation, polyvinyl butyral, a thermoplastic with a low melting point, has done an excellent job in class A applications. But, with the advance of electrical components into higher temperature operation and the development of new materials and methods demanding higher processing temperatures, there has existed a serious need for a self-bonding magnet wire that would resist higher temperature conditions.

A new product — cement-coated epoxy magnet wire—has been developed to meet these needs. This wire represents a completely new concept in the self-bonding magnet wire field. The cement is an epoxy-type system and offers a degree of thermosetting properties with tremendously high bond strength. This means that entirely new areas of application are opened up for the use of cement-coated wire, enabling design engineers to take advantage of cost savings in processing by elimination of tapes and ties, use of the new encapsulation techniques with confidence in the wire-to-wire bond, and to obtain greater rigidity and strength in electrical windings.

Bond Strength Properties

Cement-coated epoxy magnet wire can be bonded in three ways: by oven heating, by resistance heating, or by solvent. Full bond strength is realized in a single operation of short duration. Tables I and II show the relative strengths of the bond obtained with AWG size 18 round cement-coated epoxy wire and conventional (butyral) cement-coated "Formvar" wire at various high temperatures.

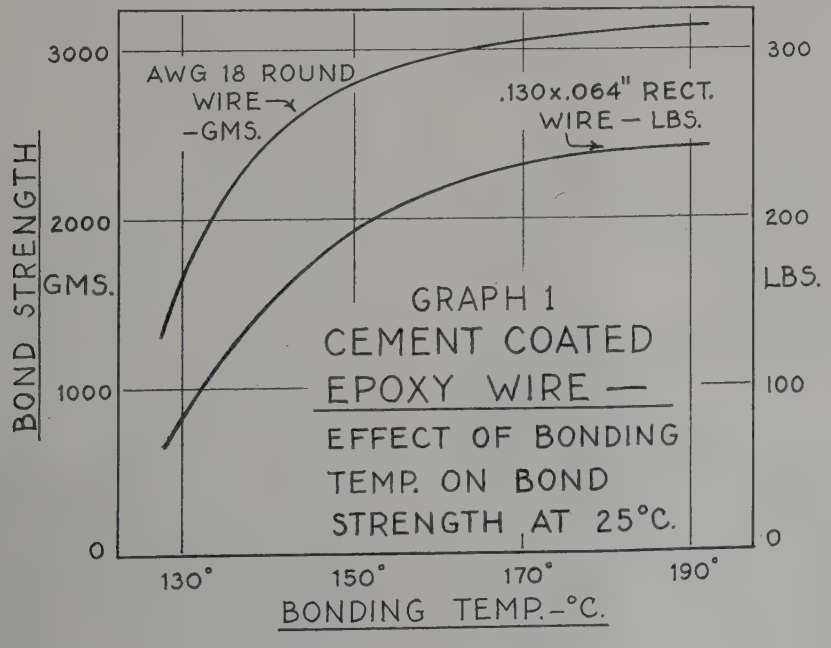


Table I—High Temperature Bond Strengths of AWG 18 Cement-Coated Epoxy Wire

Test Temp.	Bonding temp.—°C Bond Strength—grams		
°C	130°C	150°C	190°C
125°	400	415	565
150°	150	245	400
170°	110	218	190

Table II—High Temperature Bond Strengths of AWG 18 Conventional Butyral Cement-Coated "Formvar" Wire

Test Temp.	Bonding temp.—°C Bond Strength—grams		
°C	130°C	150°C	190°C
125°	395	400	510
150°	40	0	30
170°	0	0	0

The values were obtained by testing single layer coils precision wound on half-inch diameter mandrels. The coils, removed from mandrels, were oven bonded one hour at the temperatures given and reheated for 10 minutes at test temperatures. The bond strengths were then determined at the test temperatures by measuring the force required to unwind the freely rotating coil. The force required to unwind an identical unbonded coil has been subtracted from the data; hence only pure "inter-turn" bond strengths are shown.

It is obvious from the data in tables I and II that the cement-coated epoxy wire is greatly superior to conventional butyral cement-coated wire in bond strength at elevated temperatures.

The bond strength of coils wound with cement-coated epoxy magnet wire increases with elevated bonding temperatures. Test results have indicated that this wire will bond at temperatures as low as 130°C, but maximum strengths are achieved by bonding temperatures in the range of 150 to 200°C.

Graph 1 illustrates this fact for both round and rectangular cement-coated epoxy wire. The data for round wire was obtained with precision wound coils as previously described. The rectangular wire test samples were made by one inch overlapping of two straight lengths, oven bonded under light pressure for one hour.

Identical rectangular test samples were used to determine the high temperature bond strengths given in table III. This data on rectangular wire illustrates the fact that coils, wound with cement-coated epoxy wire and bonded at elevated temperatures, will have sufficient holding force to resist deformation at high temperatures.

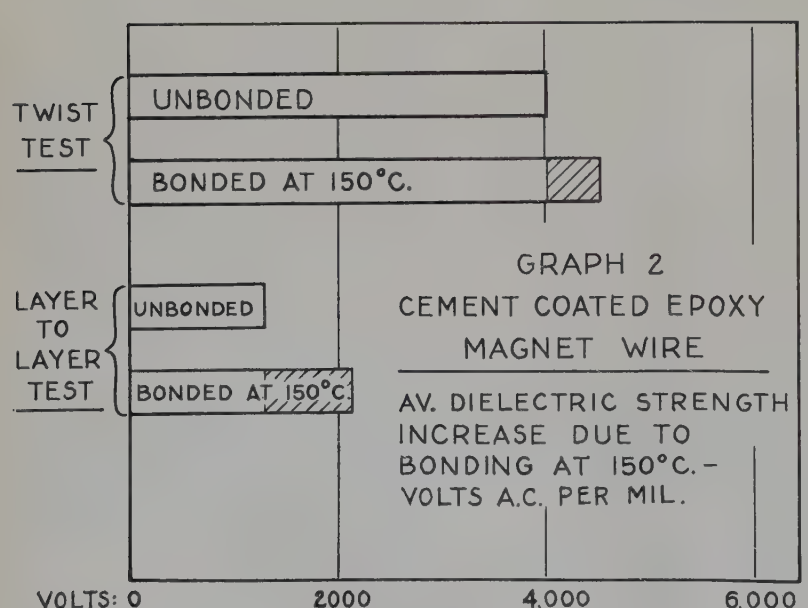
Table III—High Temperature Bond Strengths of .130 x .064" Cement-Coated Epoxy Wire—in Lbs.

Bonding and Testing Temp.—°C		
130°	150°	190°
81	44	10

Table IV demonstrates that bond strengths are fully retained in transformer oil. Rectangular wires were aged under oil in sealed glass tubes.

Table IV—High Temperature Bond Strengths of Rectangular Cement-Coated Epoxy Wire, .130 x .064", After Aging in Hot Transformer Oil

Test Temp.	Bonding Temp.—°C Bond Strength—lbs.	
°C	150°	190°
SECTION A—Wire aged 2 weeks in oil at 150°C		
130°	127	159
150°	58	75
SECTION B—Wire aged 8 weeks in oil at 130°C		
130°	119	174



The tubes were then opened and the wire test samples and oil were reheated to various test temperatures. Samples were removed individually from the hot oil and tested within several seconds.

None of the wires of the bonded pairs in the oil slipped or tilted with respect to each other during aging at 130° or 150°C, even though the test samples were all positioned vertically.

Electrical Properties

Cement-coated epoxy magnet wire, based on the AIEE 57 test procedure, with copper conductor, is a 130°C (class B) wire. Coupled with this, the wire has excellent dielectric strength due to the minimized flow tendency of the cement coat and the normal high dielectric strength of the underlying epoxy enamel. Graph 2 demonstrates that greater dielectric strength values are obtained after bonding than before. This increase in dielectric strength is evidently due to the elimination of the air layer between turns during bonding.

Other electrical properties of the wire are virtually the same as those of the underlying epoxy enamel which constitutes most of the insulation.

Compatibility

The need for compatibility of components in electrical systems has been well recognized in the last few years. One insulating material, epoxy, has gained the reputation of essentially complete compatibility with most other insulating components. Since cement-coated epoxy magnet wire is composed of a base film of epoxy enamel, and a cement-coat based upon epoxy, the overall product meets the recognized performance of the epoxy system.

This has been proven by recent tests in sealed glass tubes involving the cement-coated epoxy wire, various other insulation materials, and moisture. There was no noticeable hydrolysis effect or any other degradation effect on the cement-coated wire.

Applications

Cement-coated epoxy magnet wire possesses a balance of excellent properties which are both necessary and desirable in a large variety of appli-

cations.

One outstanding property is the ability of the cement to maintain the basic dimensions of bonded coils during cure of encapsulating or dip-coating materials. This now opens up a complete new field of application for the fluid-powder technique. Coils can be wound with this wire, bonded, and dipped hot at temperatures up to 200°C, without losing shape.

The transformer field offers many areas of application for cement-coated epoxy. The oil-filled distribution transformer industry, demanding oil compatibility, resistance to vibration, and a strong bond between wires and paper to wire, is a natural application for cement-coated epoxy.

Pancake transformer coils can be processed using this wire, and result in lower cost by elimination of extra ties or adhesives.

Television yoke coils, where greater rigidity and higher operating temperatures are required, can be wound with the cement-coated epoxy wire. The higher melting point of the epoxy cement offers advantages in winding and processing of these coils.

Many other applications in the fields of random wound coils, field coils, armatures, solenoids, standard motor windings, etc., offer possibilities of greater dependability and cost savings with cement-coated epoxy wire.

Summary

The availability of cement-coated epoxy magnet wire has eliminated the barrier that existed in the use of self-bonding wires at elevated temperatures.

Dependable dielectric strength of the cement coat, plus the retention of bond at temperatures up to 200°C, has given the electrical design engineer a new "working tool" in the field of electrical windings.

It is expected that as more laboratory and field data is gathered, it will be proven that the bond strength of the new cement-coated epoxy wire, in conjunction with present standard dipping varnishes, will produce electrical windings offering amazing resistance to unusual environmental conditions and to the effects of vibration.

European Insulation Report

Ed. Note: *The author of this monthly European report is a well-known insulation expert associated with a large European electrical manufacturer. Although it is necessary that his identity not be revealed at this time, correspondence may be exchanged with him by writing* European Editor, Insulation, Box 270, Libertyville, Illinois.

Insulation Materials for Electrical Machines of Insulation Class E

By A. R. Andersson and C. A. Tengstrand, Vol. 5, No. 1, 1960, pp. 37-40. Original title in the German edition: Isolierstoffe für elektrische Maschinen der Isolationsklasse E. A. R. Andersson (Laboratory for Insulation Materials) and C. A. Tengstrand (Design of Electrical Machines) are with ASEA, Västeras, Sweden.

After a short discussion on the present-day test techniques, the author gives results from twisted pair and motorette tests on different combinations of enamelled wire and impregnating resins. The theories and test arrangements correspond to AIEE specifications 510, 511, and 57.

On the basis of such tests, the author concludes that polyvinyl acetate enamelled wire hardly conforms to class E despite the fact that it is so classified in IEC publication No. 85 (subsidiary list). ASEA uses polyester resin (terephthalic acid base) which could belong to a class higher than class B. With class A machines the conductor is insulated with either cotton or paper. For class E machines glass yarn is sufficient. Polyester folia or fibers are also advantageous.

Cotton should not be used directly on the copper conductors for class E machines, but it can be used for the end connections of stator coils where it serves to hold the form of the coil tightly together until bonding is accomplished with the impregnating resin.

From the tests it was determined that a combination of "Mylar" film, pressboard, and an impregnating resin was highly suitable for use as slot insulation because of the excellent properties. A phenolic resin modified with oil served as the impregnating medium. Curing was carried out in an oven after impregnation. Earlier impregnating resins based on asphalt and linseed oil do not conform to the requirements.

The author reckons that insulation class A will be supplanted in the future by class E which is 15°C higher.

New Type of Glass as a Material For Electronics

By W. Hennig, Elektrotechnische Rundschau, No. 6, June 1960, pp. 233-234. Original title: Neuartiges Glas als Werkstoff der Elektronik.

This article describes a new technique involving the so-called "Fotoform" glass. By means of suitable heat treatment and with ultra-violet light, the glass is brought to a form which is more ceramic than glass and is therefore called "Fotoceram." The different corrodibility with a 5% hydrofluoric acid solution and the different sensitivity to ultra-violet rays, according to how the glass has been treated, make new and very interesting applications of such glasses possible, especially in high frequency technology.

A New High Strength Synthetic Material with Glass Fiber

By H. Heiner, Elektrotechnik und Maschinenbau, Vol. 77, Nr. 12 15. June 1960, pp. 294-295. Original title: Ein neuer hochfester Glasfaser-Kunststoff.

A glass fiber and polyester combination is described in this article. The shaping can be accomplished easily with molds made from wood or steel plates in which the mass is prepared either by hand application or by simply pouring it into the mold. Cheap pieces are possible because of the simple manufacturing process.

Physical properties

Compr. strength (20°C)	1000-1500 kg/cm²
Bending strength (20°C)	500-2000 kg/cm²
Tensile strength (20°C)	300-2000 kg/cm²
Form proof	45-85°C
Spec. weight	1.2-2.2
Thermal conductivity	0.2-0.4 $\frac{\text{cal}}{\text{m.hour.°C}}$

Heat proof: between —30°C to 65°C for tanks containing liquids, and between —30°C to 120°C for gas or steam tanks.

Chemical properties: resistant to acids, solvents, etc.

The material is highly suitable for the manufacture of tubes, tanks, basins, etc.

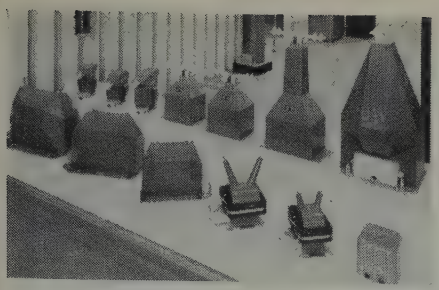
European Editor's Note: It should be noted that no electrical properties are given for the polyester mass mentioned above. In contrast to the USA, polyester resin is very seldom used for the manufacture of parts of electrical equipment in Europe. Polyester filled with glass fibers is used mainly for the manufacture of boats, tanks, etc. For high voltage electrical insulation, epoxy resins filled with quartz powder are mostly used.

The introduction of epoxy as a high voltage insulation dates from 1948, when the firms Maschinenfabrik Oerlikon (Zürich, Switzerland) and Moser-Glaser & Co. (Muttery near Basel, Switzerland) carried out pioneering work. These were described, among others, in the "Bulletin des schweizerischen elektrotechnischen Vereins" 1949 Nr. 13 and 1950 Nr. 19 by Imhof and 1950 Nr. 1 and in Report 124 of CIGRE by H. Koller.

Patent difficulties at first held back many firms but epoxy resins are now widely used.

The epoxy resins are poured hot (at ca. 100°C) into the forms. This seems to me to be the basic reason why there was no sympathy in the USA for this technique as there was in Europe. Because, from the standpoint of costs, this is an expensive technique in America due to the higher wages.

The casting, embedding, and recasting techniques with filled epoxy resins (filler is mostly quartz powder) have been variously described. Insulating supports, bushings for bus bars, load switches for transformers, parts of extinction chambers, parts of lightning arresters, etc., as well as current



Epoxy cast current and potential transformers.

and potential transformers as shown in the figure, are recastings of the classical type. I shall reproduce, in this and especially in the next issue, a few extracts from such articles which are representative of the epoxy casting techniques in Europe. Unfortunately, there are very few up-to-date articles so that I will have to go back to publications of up to two years ago. But these have changed very little, other than the manifold applications.

Insulation Problems with D-C Traction Motors

By Arno Oppel, AEG Mitteilungen, vol. 50, No. 3/4, March/April 1960, pp. 181-183. Original title: Isolationsproblem bei Gleichstromfahrmotoren.

Such motors have self ventilation which permits a lot of water, dust, humidity, etc., to enter the machine. Snow water, especially, which contains a lot of salt (which is strewn in order to prevent freezing of the rails, sidings, etc.) is dangerous. The field coils which lie on the bottom portion of the casing are endangered the most. The insulation wears out if the coils are not fixed properly on the pole or as a result of aging of the insulation.

These coils are now cast directly on the pole with an epoxy resin. Extensive tests have shown that unsaturated polyester resin did not satisfy the class B temperature requirements.

Epoxy resin filled with glass fibers did not have the desired mechanical strength in all directions. Besides this, voids could not be avoided and this had the effect of worsening the thermal conductivity. As a filler, quartz powder gave the best results. Also, the greater the proportion of the quartz filler in the resin, the better the thermal conductivity. The types of curing agent and epoxy resin (high and low molecular respectively) had an influence on the thermal conductivity. The author gives a value for the thermal conductivity as lying between 0.162 to 0.203

$$\frac{\text{kilo cal}}{\text{meter} \cdot \text{hour} \cdot {}^\circ\text{C}}$$

It is not clear whether this is for filled or non-filled resin.

The coils which are cast on the pole core withstood 10,000 heat cycles (lower temperature 100°C, upper 170°C). After 2500 cycles the samples were deposited inside a cattle salt solution for 8 days. The 150°C warm coils were dipped directly into the cold solution.

Mechanical tests on the filled resin have shown that the impact strength values are from 500 to 700 times the earth's gravitation "g."

A Special Application of Epoxy Resin In Electrical Design at Merlin-Gerin

By M. Danchin, Merger Magazine, Nr. 45 pp. 23-29. M. Danchin works in the research department (insulation section) of Merlin-Gerin, Delle, France. Original title: Une utilisation particuliere des résines époxydes dans la construction électrique Merlin-Gerin.

The chemical reaction between the curing agent and the resin is not a classical polymerization, but more of a poly-addition or copolymerization. But it will be termed here and in other places as polymerization.

The resin can be cured and cast at over 100°C. It is free of solvents and nothing therefore escapes during polymerization. A homogeneous casting without voids is therefore possible as is necessary for high voltage insulations. Also, no compression is necessary. The resin is highly suitable because it penetrates into all the corners of the casting form.

The polymerization of polyester is a highly exothermic process whereby a shrinkage of up to 12% of the volume is possible. Dangerous tension can thereby arise in the casting which can result in cracks in the material.

However, this is not the case with epoxy resins. A heavily filled resin (up to eight times the weight of the pure resin) exhibits a shrinkage similar to steel or aluminum.

The Martens point is at approximately 120°C, although it can also be withstood at 150°C after a small mechanical stress. The age proof under voltage, mechanical bending, and ozone values are given. Three mm thickness is sufficient for a 50 c/s voltage of 60-70 kv.

The mechanical properties are significant:

Modulus of Elasticity	1000 kg/mm²
Compressive strength	20 kg/mm²
Tensile strength	6-8 kg/mm²
Bending strength	10-13 kg/mm²
Impact strength	15 kg cm/cm²

The values were obtained from measurements according to UTE C 46.

The article shows pictures of parts of switches, insulating supports, and insulation of extinction chambers which are cast with filled epoxy.

The author doubts whether epoxy could be used for outdoor equipment because of the danger of creepage arising from dirt and other contaminants, but tests are being conducted everywhere so that this point will also be soon clarified.

Registration

Electrical Insulation Conference Report

Another smashing success for the National Conference on the Application of Electrical Insulation took place at the Conrad Hilton Hotel, Chicago, December 5-8. Registration for this, the third annual conference, was about 2100. This is an increase of approximately 400 over the registration for the second conference which was held in Washington, D.C., last year.

Interest in the technical sessions was exceedingly high, with many of the session rooms being filled even though seating capacity in some was 400 to 500. A preprint of the technical papers was included in the registration folder, and the actual presentations were limited in most cases to short outlines, slides, and movies to illustrate the more important points. Thus, questions could be formulated prior to the presentation of the paper and then discussed during the time allotted for this purpose after each paper.

Technical Sessions

Unity of Action Banquet

With the Grand Ballroom filled with the important men in the industry . . . considerably more than the 1200 who attended the banquet last year . . . the Unity of Action Banquet was also a great success.

The welcoming speech and the introductions of the many honored guests were made by Walter F. Hugger, Electro-Technical Products Div., Sun Chemical Corp., who was also chairman of the banquet arrangements. Conference General Chairman Wilbur G. Hoffer then briefly discussed the conference and its goals before turning the podium over to Toastmaster Clinton B. Burnett, Johns Manville Corp.

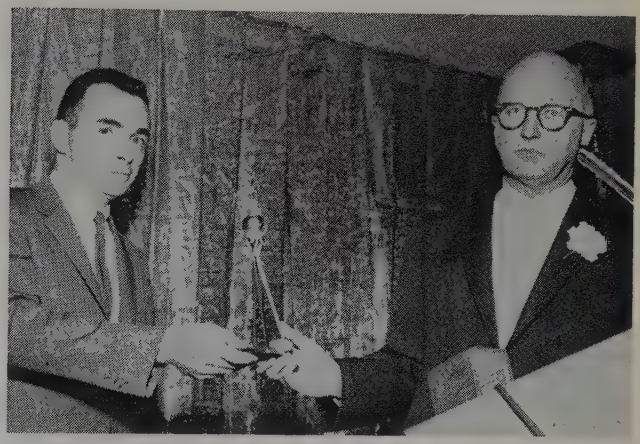
Kelly Given 'Golden Omega'

The second annual "Golden Omega" award was presented to Dr. Mervin J. Kelly, who is now a private consultant. He had been with Bell Telephone Laboratories for 41 years, most recently as Chairman of the Board of Directors. In his talk he briefly mentioned the development of the transistor, which was announced by Bell in 1948 while he was executive vice president. He also remarked extemporaneously on the need for more participation in government and civic activities by men from all levels of life, but especially from the corporate level. The principal speaker, Walker Lee Cisler, Detroit Edison Co., he said, was an excellent example of one of those who have done much in this area.

Speaking on "Progress Through Unity of Action," Cisler traced some of the achievements in the electrical field which were made possible by unity of action and stated that "future progress in power generation, trans-

Unity of Action Banquet

AIEE European Technology Luncheon

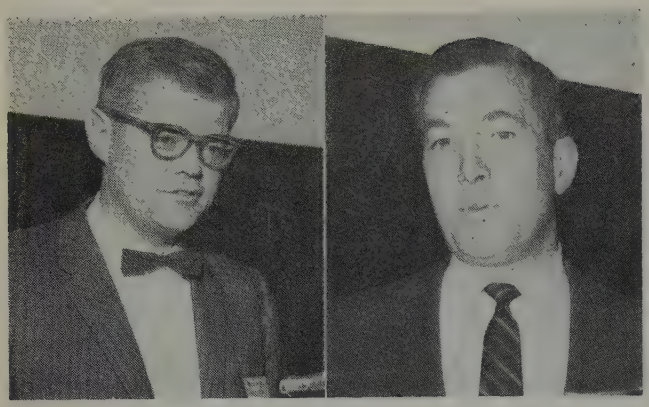


Golden Omega Award

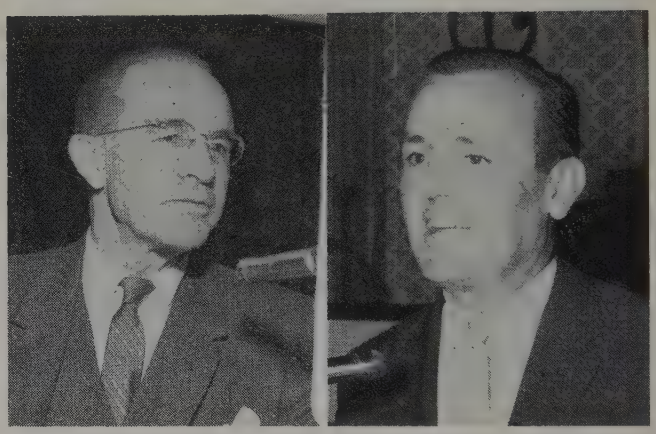
NEMA Insulation Progress Dinner

mission and distribution will depend to a substantial degree upon progress in the development and use of insulating materials." He then mentioned several types of electrical equipment in which the development of improved insulating materials is needed, such as main turbine-generators, transformers, circuit breakers, power lines, and high voltage underground cables.

To illustrate some of the problems which the electrical industry is facing, he stated that our nation will need a power generating capability of between 625 and 875 million kilowatts by 1985, compared with present capability of 176 million kilowatts. Thus, power systems must



Marketers' Meeting



be enlarged from 3½ to 5 times their present generating capability. He also predicted that the development of improved nuclear fuel cycles may allow the cost of nuclear power to be brought into line within the next 10 years.

AIEE European Technology Luncheon

The luncheon sponsored by the Electrical Insulation Committee of the American Institute of Electrical Engineers was highlighted by a very interesting and comprehensive discussion of the past and present status of the insulation industry in Europe by Dr. Richard Vieweg of the Physikalisch-Technische Bundesanstalt, Braunschweig, Germany.

NEMA Progress Dinner

The large group attending the First Annual Insulation Progress Dinner, sponsored by the Insulation Materials Division of the National Electrical Manufacturers Assn., was enthralled by a discussion of materials problems in space applications by Capt. Walter H. Flint, a range scheduling officer at the Air Force Missile Test Center, Cape Canaveral, Fla. Flint is also Atlantic Missile Range Recovery consultant to the U. S. Navy Recovery Commander on Project Mercury, the man-in-space project. He used slides and some dramatic films to illustrate his discussion of the application of electrical and electronics equipment in missile launching, and gave late information on the Atlas, Titan, Polaris, Thor, and Pershing missiles.

The dinner, a new feature of the conference, was presided over by the chairman of the NEMA Insulating Materials Div., E. R. Perry, National Vulcanized Fibre Co.

Marketers' Meeting

The final morning of the conference was devoted to a Marketers' Meeting and Luncheon. The most unusual of the talks was one on "How the Customer Should Treat the Salesman of Electrical Insulation," by T. C. Keegan, Federal Electrical Insulation Co. The Merry Insulation Player Troupe and Marching and Chowder Society (R. E. Joseph, Allis-Chalmers Mfg. Co., W. A. Carlstrom, Insulation Manufacturers Corp., and R. W. Swenson, Minnesota Mining and Mfg. Co.) gave a very entertaining skit on "How To Sell Insulation."

At the luncheon, Marketing Chairman E. J. Phelan, Prehler Electrical Insulation Co., presented Harry H. Chapman, Jr., Owens-Corning Fiberglas Corp., with the annual Marketing Award. Bill Gove, nationally known sales consultant and guest lecturer, was the speaker.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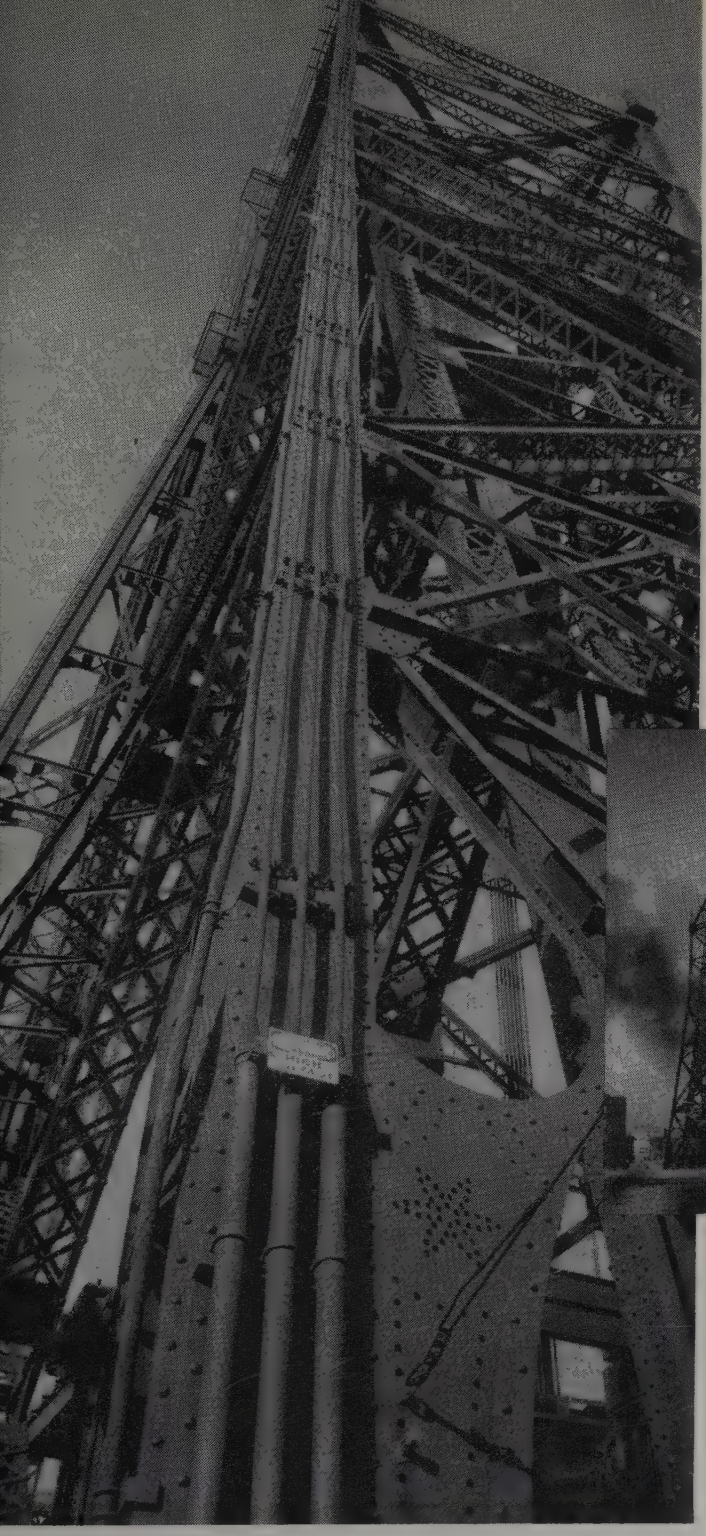
CASTING RESINS
LAMINATES TAPES
ROME CABLE DIVISION of ALCOA

Vibration... Intense Cold...

POLYETHYLENE-INSULATED CABLES DEFY RIGOROUS BRIDGE CONDITIONS!



Early in 1955, at temperatures well below zero, three 14-kv power cables insulated with BAKELITE polyethylene and jacketed with Densheath PVC were installed on this aerial lift bridge at Duluth, Minn. Five winters later, the cables are still giving dependable service, despite the hazardous conditions of bridge vibration and extreme cold. Cables were manufactured by the Anaconda Wire and Cable Company for the Minnesota Light and Power Company.

Bridge installations provide one of the most rigorous physical tests for power cables. Only the toughest insulation can withstand for extended periods the damaging effects of bridge vibration . . . especially at low temperatures.

Three high-voltage cables insulated with BAKELITE polyethylene have passed such a test and, after five years, are still giving unfailing service. The polyethylene insulation has resisted not only the expected mechanical abuse, but the frigid Minnesota winters as well. Average winter temperatures in this area are 10 to 15 deg. F. and temperatures may reach as low as —41 deg. F.

Insulation of BAKELITE polyethylene has proved to be tough, durable, highly resistant to moisture and cracking, and an excellent low-loss dielectric . . . even at low temperatures. Union Carbide Plastics Company has pioneered the development of polyethylene and vinyl insulating and jacketing materials for optimum performance under severe conditions. For specific information on BAKELITE polyethylene and vinyl compounds, please write to Dept. HG-75, Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, New York. *In Canada:* Union Carbide Canada Limited, Toronto 12.

UNION CARBIDE

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Index to Insulation's 1960 Editorial Articles

Listed below are the titles of the major articles that appeared in *Insulation* from January 1960 through December 1960. They are grouped according to broad classifications. Although an article is listed under the most logical heading as determined by its subject matter, it may also contain information relative to other subject headings. Articles appearing in three regular departments of *Insulation* have been indexed for easier reference: Insulation Forum, Pixilated Patents, and European Insulation Report.

Other regular departments appearing in *Insulation* but which have not been indexed include: Association News, Dates to Circle, From the Editor, Industry News, NEMA Electrical Insulation Index, New Literature, New Products, New Publications, News and Views, and People in the News.

General Interest, News, and Miscellaneous Articles

European Insulation Report

Insulation Forum

Pixilated Patents

Association News

National Electrical Week To Be Observed Feb. 5-11

Plans to make the 1961 observance of National Electrical Week, Feb. 5-11, another outstanding industry endeavor were formulated recently by the National Electrical Week Committee.

The 1961 Planning Guide which provides details of how various participating groups can plan and carry out their own National Electrical Week observances is being distributed and more than 80 companies have been contacted for advertising support.

Electrical Engineers Exhibition In London, March 21-25

The Electrical Engineers Exhibition at Earls Court, London, will open on March 21st for five days. Signalling and communications will be featured.

Provisional space bookings have increased this year, and over 460 of Britain's leading electrical manufacturers will show their latest developments to the trade. Requests for space have been received already from over 30 new exhibitors.

The number of visitors is expected to exceed the 76,000 who came to the 1960 show. The exhibition is sponsored by the Association of Supervising Electrical Engineers. For further information, write to 6 Museum House, 25 Museum St., London, W. C. 1.

SPE ANTEC Program Features

Four guest lecturers on quality control and technical sessions on newest aspects of the plastics industry will be featured at the 17th Annual Technical Conference of the Society of Plastics Engineers. The program, to be held at the Shoreham Hotel in Washington, D. C., January 24-27, will consist of more than 125 technical papers.

Sessions have been scheduled to discuss technology of basic plastics operations and applications such as extrusion, finishing, foams, and injection molding. In addition, the program for 1961 has been expanded to include a series of papers on specialized aspects of plastics, such as weathering, crosslinking, plant and safety engineering, evaluation procedures, and flammability. As in previous years, technical sessions will be terminated in mid-afternoon to permit time for the annual meetings of the Society's 15 Professional Activity Groups.

The Annual Business Meeting of the Society will take place at a luncheon on Wednesday noon, January 25, and an Education luncheon will take place Tuesday, January 24. On Thursday evening, the 26th, the customary "speechless" Conference Banquet will be held in the Sheraton-Park. A special ladies' program has been arranged for wives of conference registrants.

General chairman is Gordon M. Kline, National Bureau of Standards. Vice Chairman, program, is Albert Lightbody and speakers committee chairman is Henry A. Perry, both of the Naval Ordnance Laboratory. Frank W. Reinhart, National Bureau of Standards, is vice-chairman, arrangements. Others on the Conference Executive Committee include Myron G. DeFries, Atlantic Research Corp., and Taylor A. Birkhead, Birkhead Corp., ANTEC secretary and treasurer, respectively.

Military Electronics Convention

The 2nd Winter Convention on Military Electronics will be held at the Biltmore Hotel, Los Angeles, February 1-3. The meeting is sponsored by The National Professional Group on Military Electronics and the Los Angeles Section of the Institute of Radio Engineers. Only one social event and two field trips are being scheduled. The technical program will consist of 80 papers, which will be presented Wednesday afternoon, Thursday morning and afternoon, and Friday morning and afternoon. Some thought is also being given to having classified exhibits.

ASTM To Hold Symposium on Materials And Electron Device Processing

The American Society for Testing Materials will hold a three-day symposium on Materials and Electron Device Processing, April 5-7, at the Benjamin Franklin Hotel, Philadelphia, Pa. The symposium, sponsored by ASTM Committee F-1 on Materials for Electron Tubes and Semiconductor Devices, will deal principally with the chemistry and physics of device processing.

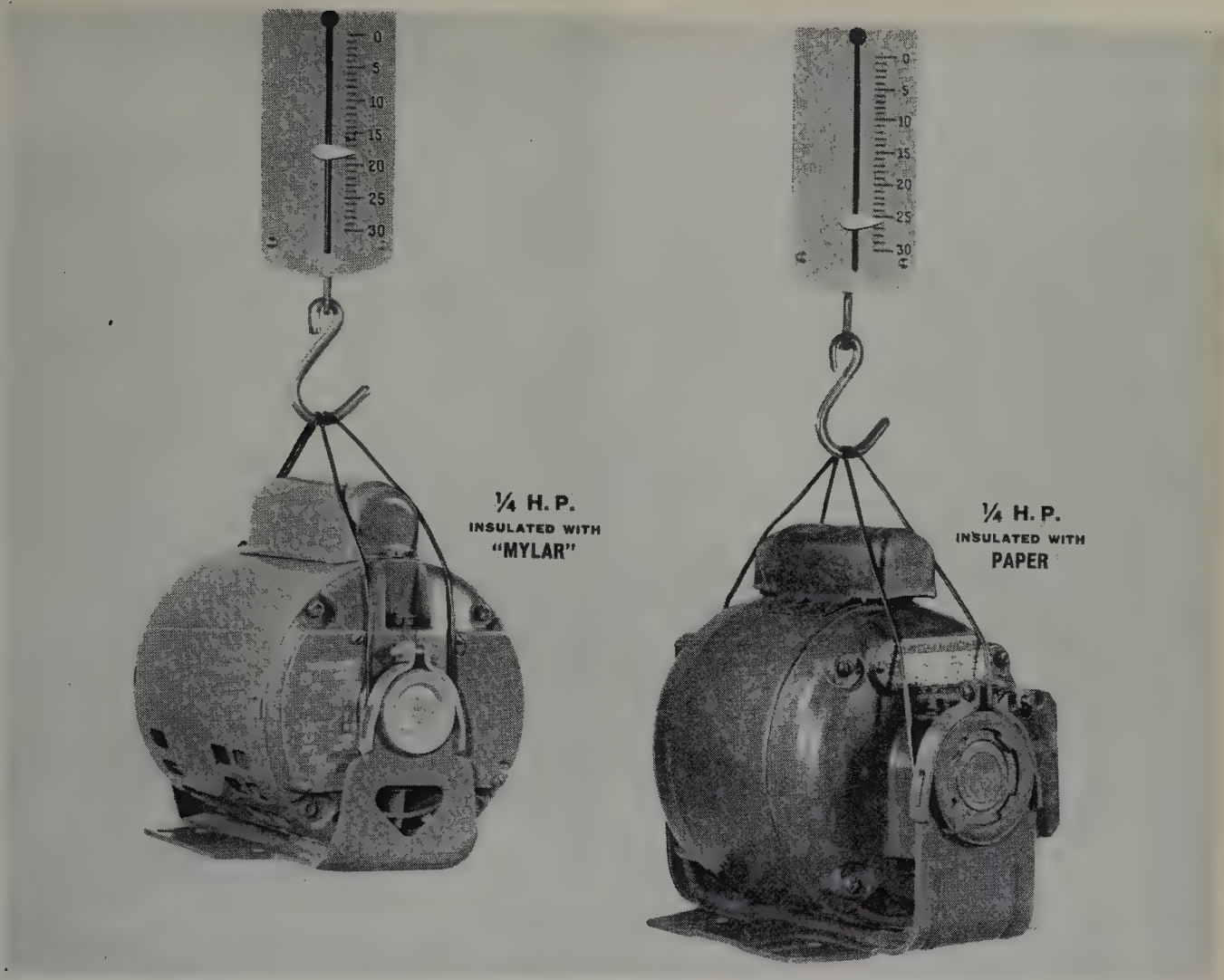
Areas to be covered will include detection and removal of contaminants from device materials; examination and evaluation of materials and device processing facilities, such as chemical etchants and solvents; ambient conditions including furnace atmospheres and dust and lint control; and finally, the chemistry and physics of device activation and reliability.

A number of papers have already been submitted. Additional papers are invited. Those desiring to submit a paper for consideration should submit the title and 200 word abstract to Dr. D. E. Koontz, Bell Telephone Laboratories, Murray Hill, N. J. Titles and abstracts should be in Dr. Koontz's hands not later than January 2. Manuscripts are desired by February 15.

NISA Will Hold 1961 Convention In San Francisco, June 11-14

The 28th Annual Convention of the National Industrial Service Association, which will become the Electrical Apparatus Service Association on April 1, will be held in San Francisco, June 11-14, 1961, at the new Jack Tar Hotel. Plans to hold the 1961 convention in Denver, Colorado, had to be cancelled when hotel exhibit and dining facilities proved to be inadequate for the association's growing needs.

A site for the 1962 convention, originally scheduled for San Francisco, has not yet been announced. The association plans to hold its 1963 convention in Chicago and its 1964 convention in New York.



Motors insulated with Mylar® are smaller . . . lighter

Motors above have the same rating, but the smaller, lighter one takes advantage of "Mylar"* polyester film for slot and phase insulation.

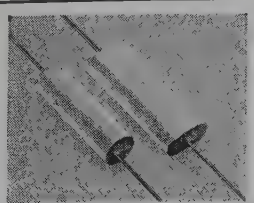
Because of its excellent electrical and physical properties, "Mylar" can be used in thin gauges to help reduce motor size up to 40% and weight up to 33%. The thermal stability of "Mylar" allows motors to run hotter and develop more horsepower from a given frame size.

Insulation of "Mylar" contributes built-in reliability and longer life to appliance motors because its properties do not change over long periods of continuous operation at high temperatures or when exposed to chemicals, solvents and lubricants. And because "Mylar" is unaffected by moisture, current leakage and shock hazard are cut to a minimum. And yet, motors insulated with "Mylar" frequently cost no more than those using other common types of insulation.

Whether you manufacture or buy electrical products, you can get improved performance with Du Pont "Mylar". And, figured on a square-foot basis, "Mylar" will often cost you less than your present material. For full facts on "Mylar", write for free booklet. E. I. du Pont de Nemours & Co. (Inc.), Rm. #14, Film Department, Wilmington 98, Delaware

Tough, thin "Mylar" has this unique combination of properties for superior insulating performance.

- Average 4,000 volts per mil dielectric strength (ASTM D-149). Average power factor of 0.002 at 60 cycles.
- Thermal stability from -60°C. to Class B range.
- Chemical and moisture resistance.
- Resistance to aging, abrasion, tearing and rotting.



IN CAPACITORS—Units insulated with "Mylar" have superior moisture resistance and longer life . . . meet highest reliability standards.

*"*Mylar" is Du Pont's registered trademark for its brand of polyester film.*

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Better Things for Better Living . . . *through Chemistry*

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MYLAR®
POLYESTER FILM

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New Publications

Books

Electric Motor Repair Shop—Problems and Solutions, by Samuel Heller. This book contains an accumulation of problems involving both a-c and d-c equipment as they occur in the repair shop or laboratory, with step-by-step answers. Also indicated are special cases where the specific answer may not apply to a similar problem or where other solutions may be possible. $5.95. Datarule Publishing Co., Box 69, Scarsdale, N.Y.

Handbook of Chemistry and Physics. New 42nd edition of this reference source has five indexed sections: mathematical tables, properties and physical constants, general chemical tables, heat and hygrometry, and quantities and units. $12. Chemical Rubber Publishing Co., 2310 Superior Ave., Cleveland 14, Ohio.

Symposium on High-Voltage Cable Insulation—STP 253. Emphasis is placed on the requirements for materials, for their proper application, and on test methods that will reveal the capabilities and faults of insulation systems used for extra high voltage transmission. Heavy paper cover, 39 + v pages, 6″ x 9″, $1.50. American Society for Testing Materials, 1916 Race St., Philadelphia 3.

Materials in Nuclear Applications —STP 276. Contains four papers describing the existence of long-lived, chemically active, free radicals in irradiated polymers. One covers some of the recent techniques for studying the identity, concentration, and lifetime of these species. The other three deal with actual postirradiation changes in physical and chemical properties of a few selected polymer systems. Hard cover, 344 + vi pages, 6″ x 9″, $8.25. American Society for Testing Materials, 1916 Race St., Philadelphia 3.

Encyclopedia of Science and Technology. Covers all fields of life science, physical science, earth science, and engineering, and also includes the major applications of these fields in other technologies. To keep the 15 volume set up-to-date, there will be a continuous revision program as well as an annual supplement. Encyclopedia Div., McGraw-Hill Book Co., 330 West 42nd St., New York 36.

Vacuum Technology Transactions. Contains the proceedings of the 6th National Symposium sponsored by the American Vacuum Society in 1959, in which 58 technical papers were presented. 872 pages, 11″ x 8½″, $17.50. Pergamon Press Inc., 122 East 55th St., New York 22.

The Structure of Glass, Volume 2. Contains papers presented at the Third All-Union Conference on the Glassy State held in Leningrad, November 1959. It presents a complete account of research work on the glassy state since the last conference, held in 1953. Clothbound, 492 pages, $25. Consultants Bureau Enterprises Inc., 227 West 17th St., New York 11.

American Standard Requirements for Varnished Cloth Insulated Cables, C8.13-1960. $2. American Standards Assn., Dept. PR187, 10 East 40th St., New York 16.

Government Publications

The following government publications of interest to the electronic industry may be obtained by ordering directly from the U.S. Gov't Printing Office, Division of Public Documents, Washington 25, D.C.

Armed Services Procurement Regulations, Catalog No. D 1.13:960, $18 per year.

Electrical Study Guide, Catalog No. FS 5.280:80006, 75 cents.

Electronic Study Guide, Catalog No. FS 5.280:80009, 70 cents.

Government Purchasing Directory, Catalog No. SBA 1.13/3:960, 60 cents.

Electronic Test Methods, Catalog No. D 7.10:202B, 65 cents.

High Temperature Ceramics, Catalog No. C 13.44:6, 20 cents.

Military Electron Tubes, Catalog No. D7.6/2:211, $3.25.

1001 lead wires in stock

all types, sizes, insulations,
colors, temperature ranges

by Belden

Over fifty million feet of lead
wire is in stock . . .
available for immediate shipment

Ask for Belden Lead Wire
Catalog L59

Belden
WIREMAKER FOR INDUSTRY
SINCE 1902
CHICAGO

magnet wire • power supply cords •
cord sets • portable cordage •
control cables • electronic wire

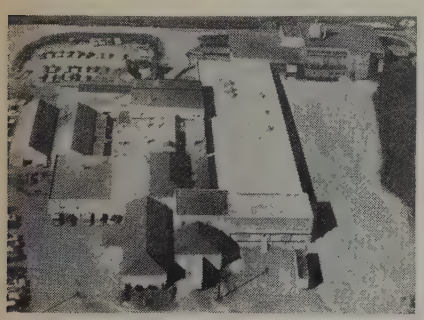
Industry News

Office and laboratory building space at *John C. Dolph Co.*, Monmouth Junction, N.J., insulating varnish manufacturer, has been doubled and new laboratory equipment installed.

Robertshaw-Fulton Controls Co. has purchased six acres in suburban Richmond, Va., on which it will build a two-story corporate headquarters. The company has also opened a new Eastern Research Center in King of Prussia, Pa., and a new thermostat manufacturing plant near Youngwood, Pa.

Consolidation of the steam turbine and heat transfer departments into the new thermal power department has been accomplished at the Power Equipment Div., *Allis-Chalmers Manufacturing Co.*, Milwaukee, Wis.

In a $250,000 addition to its Middlefield, Ohio, plant, *Geauga Indus-*



tries, a subsidiary of *The Carlisle Corp.*, is now producing transfer molded plastic parts on an automatic production line.

A 2,000-ton plastic laminate press has been installed at the *Laminated Products Dept., General Electric Co.*, Coshocton, Ohio. In New York City, a company spokesman said G-E is engaged in five new ventures: 1) power generation from nuclear sources and other promising new power sources; 2) jet engines for commercial aircraft and stationary gas turbines for industry and utilities; 3) space vehicle and related activities; 4) specialized and all-purpose computers; 5) industrial electronic projects directed toward automation. Net sales for the first nine months of 1960 amounted to $3,053,223,000, down 3% from the same period last year. Net earnings were $168,935,000, down 11% from 1959.

Atlas Engineering Co. Inc., Roxbury, Mass., transformer manufacturer, expects to complete construc-

tion of a new plant with 36,000 sq ft of manufacturing area in February.

Whirlpool Corp., St. Joseph, Mich., has established a new Icemaker Component Div. to develop and market automatic icemaker units.

Chance Vought Aircraft Inc., Dallas, Tex., is changing its name to *Chance Vought Corp.* to reflect the company's diversity more accurately.

A new firm, *Erie County Plastics Corp.*, Corry, Pa., has been set up to custom mold thermoplastic items for the appliance and automotive industries.

Paisley Products of Canada Ltd., Scarborough, Ontario, has been appointed Canadian sales representative for the *Mycalex Corp. of America*, manufacturer of glass-bonded mica, ceramoplastics, and synthetic mica products.

A 43,000 sq ft building is being constructed in Springfield, N.J., by

Victory Engineering Corp., Union, N.J., manufacturer of thermistors and other electronic equipment.

The *Gudebrod Bros. Silk Co. Inc.*, New York City electronic tape manufacturer, is celebrating its 90th anniversary this year.

Thermal Wire of America, Keeler's Bay, South Hero., Vt., manufacturer of high temperature wire and cable, has appointed the *Edwards-Lohse Co.*, Cleveland, Ohio, to represent it in Ohio, Kentucky, West Virginia, western Pennsylvania, and Michigan.

Electro Nuclear Systems Corp., Minneapolis, will move to a new 25,000 sq ft building in the new Science Industry Center in suburban Minneapolis as soon as it is completed, probably this spring.

Polymethylene polyphenylisocyanate, which can be used to make high temperature resistant urethane foam systems, adhesives, curing and stabilizing agents, etc., has been reduced in price from $2.25/lb to $1.50/lb in drum lots by the *Carwin Co.*, North Haven, Conn.

Rogers Corp., Rogers, Conn., has begun production of a new high temperature transformer insulation material under a license from Westinghouse Electric Corp. It will be used in Westinghouse's "Insuldur" power and distribution transformers.

General Dispersions Inc. is now producing its nylon dispersions and solutions in a new plant in Bloomfield, N.J.

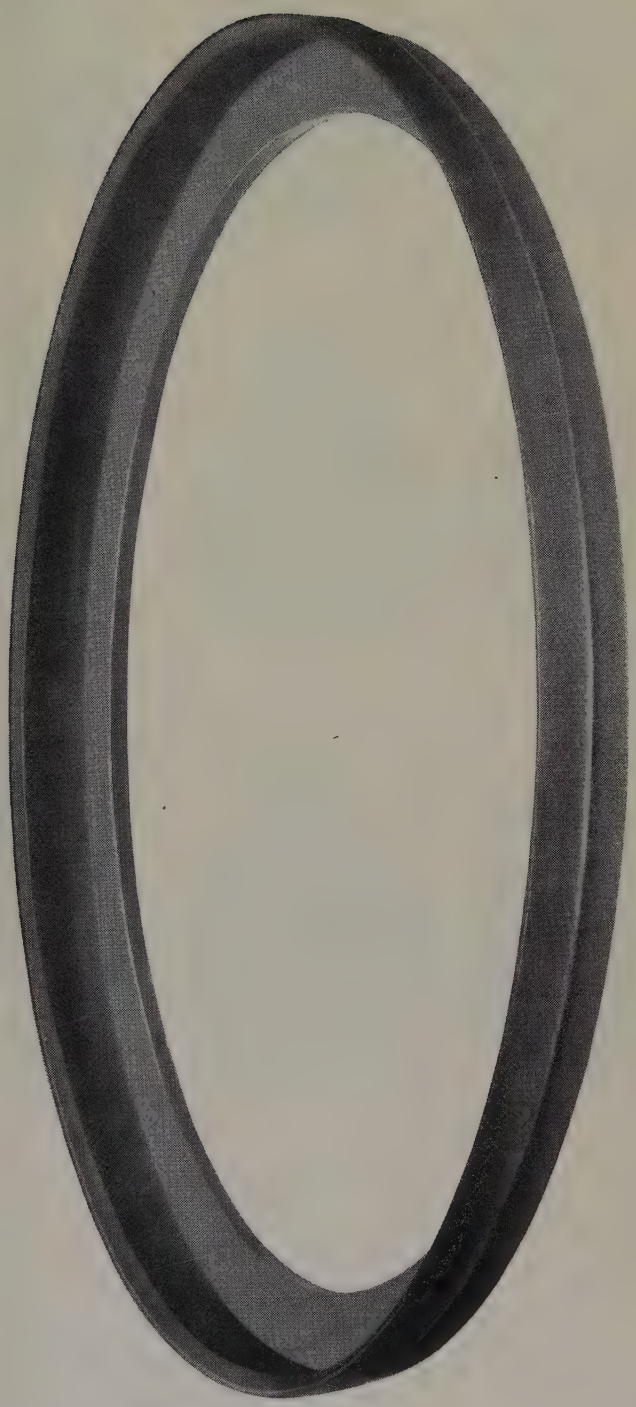
Philco Corp. has made its communications systems department a Division, the fifth within its Government and Industrial Group. Headquarters will be in a new building at Fort Washington, Pa.

Three subsidiaries of *Godfrey L. Cabot Inc.*, Boston, Mass., *(Cabot Carbon Co., Cabot Shops Inc.*, and *Cabot Gasoline Corp.)* have been merged into newly organized *Cabot Corp.*

Sylvania Electronic Tubes, a division of *Sylvania Electric Products Inc.*, Mountain View, Calif., has changed the name of its Special Tube Operations to Microwave Device Operations.

Centralab, the electronics division of *Globe-Union Inc.*, Milwaukee, has installed a new kiln capable of producing 99% high aluminas that will withstand temperatures of 3000-3200°F.

Royco Instruments Inc., manufacturer of temperature-measuring instruments, has moved to a 6250 sq ft structure in Palo Alto, Calif.



Simple only in appearance, this forward insulating ring supplies the high mechanical and electrical properties for a critical naval ordnance application. Fabricated by CDF from glass fabric epoxy tube, this ring illustrates an effective combination of material properties and manufacturing techniques.

Result: an insulating component with high strength-to-weight ratio, low water absorption, low thermal conductivity, inherent fungus resistance, and high dimensional stability.

CDF CONTINENTAL-DIAMOND FIBRE

CONTINENTAL-DIAMOND FIBRE CORPORATION, NEWARK, DELAWARE • A SUBSIDIARY OF THE Budd COMPANY

NEW FROM WESTINGHOUSE MICARTA

Micarta has flame retardant glass polyester laminates with unequalled water resistance. You can prove this with a simple test. All you need are Micarta samples, any competitive samples you select, an analytical balance and a copy of ASTM test method D-570-54T. Try it in your laboratory. You'll find that the Micarta polyester absorbs far less moisture and retains its excellent electrical properties. Another big benefit you can prove at the same time: Micarta polyester laminates weigh and cost less per square foot than any others.

Complete data, samples and test assistance are readily available through the nearest Micarta Fabricators Association member or the Westinghouse Sales office. Check the Yellow Pages. Or contact Westinghouse Electric Corporation, Micarta Division, Hampton, South Carolina. You can be sure . . . if it's Westinghouse.

Micarta makes solid, flexible and liquid materials for all your insulation needs.

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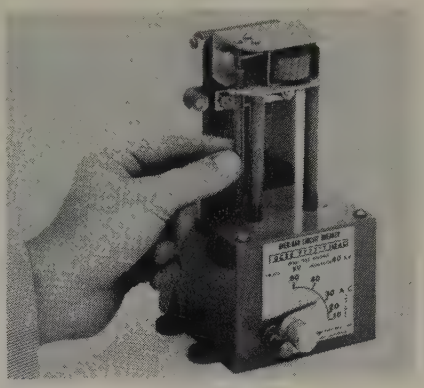
Epoxy Glass Tubing Replaces Phenolic Rod

A switch to epoxy glass tubing in place of solid phenolic rod for insulating and mechanical components reportedly has worked advantageously for Jennings Radio Mfg. Co., San Jose, Calif., on several models of overcurrent relays and switch mounts. The tubing is Phenolite grade G-11-3681 epoxy resin bonded glass fabric base material made by National Vulcanized Fibre Co. Jennings uses it in



place of solid phenolic rod as insulation between high and low voltage points. It is much lighter than phenolic rod, yet has equal or better mechanical and electrical properties.

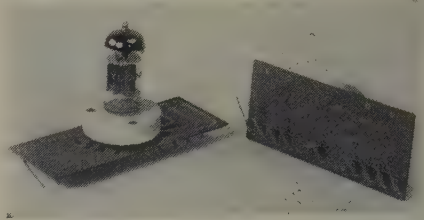
The epoxy glass tubing is used for standoff posts, insulating actuating links, and in an experimental unit as an insulating casing. As an insulated actuating link, its lower inertia allows faster operating cycles and reduces switching shock.

For Jennings' applications, the epoxy glass tubing is claimed to have several other important features. It's as effective an insulator as phenolic rod, having high insulation resistance and dielectric strength. Water absorption is low and dimensional stability is high where humidity is excessive. In addition, it doesn't require a protective finish after machining to prevent water absorption as does phenolic rod.

Although epoxy resin glass base laminates are more expensive pound for pound than phenolic laminates, Jennings reports that the cost of their tubing is actually lower than the phenolic rod they had been using. This is because the overall weight is much less.

Glass-Ceramic Tube Carrier Circuits

Chemically machined glass ceramic boards that transport 154 electron tubes at once through a newly designed automatic conveyor tester were recently put into operation in the re-



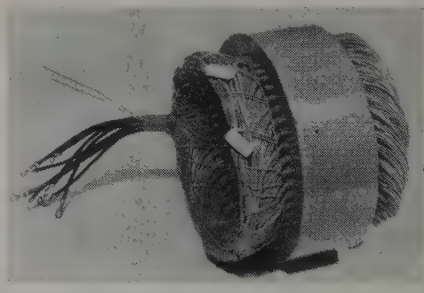
ceiving tube headquarters of Sylvania Electric Products Inc. at Emporium, Pa.

The computer-programmed machine performs up to 23 separate measurements per cycle, depending on the tube type being tested. Different sockets permit testing of hundreds of tube types. Capacity of the machine is 2,500 tubes an hour.

The glass-ceramic boards are produced by a photographic-chemical etching process by Corning Electronic Components, a department of Corning Glass Works, Bradford. Pa. The pattern of holes and slots is implanted in photosensitive glass, then the image is etched away. The glass is then converted to a glass-ceramic called "Fotoceram."

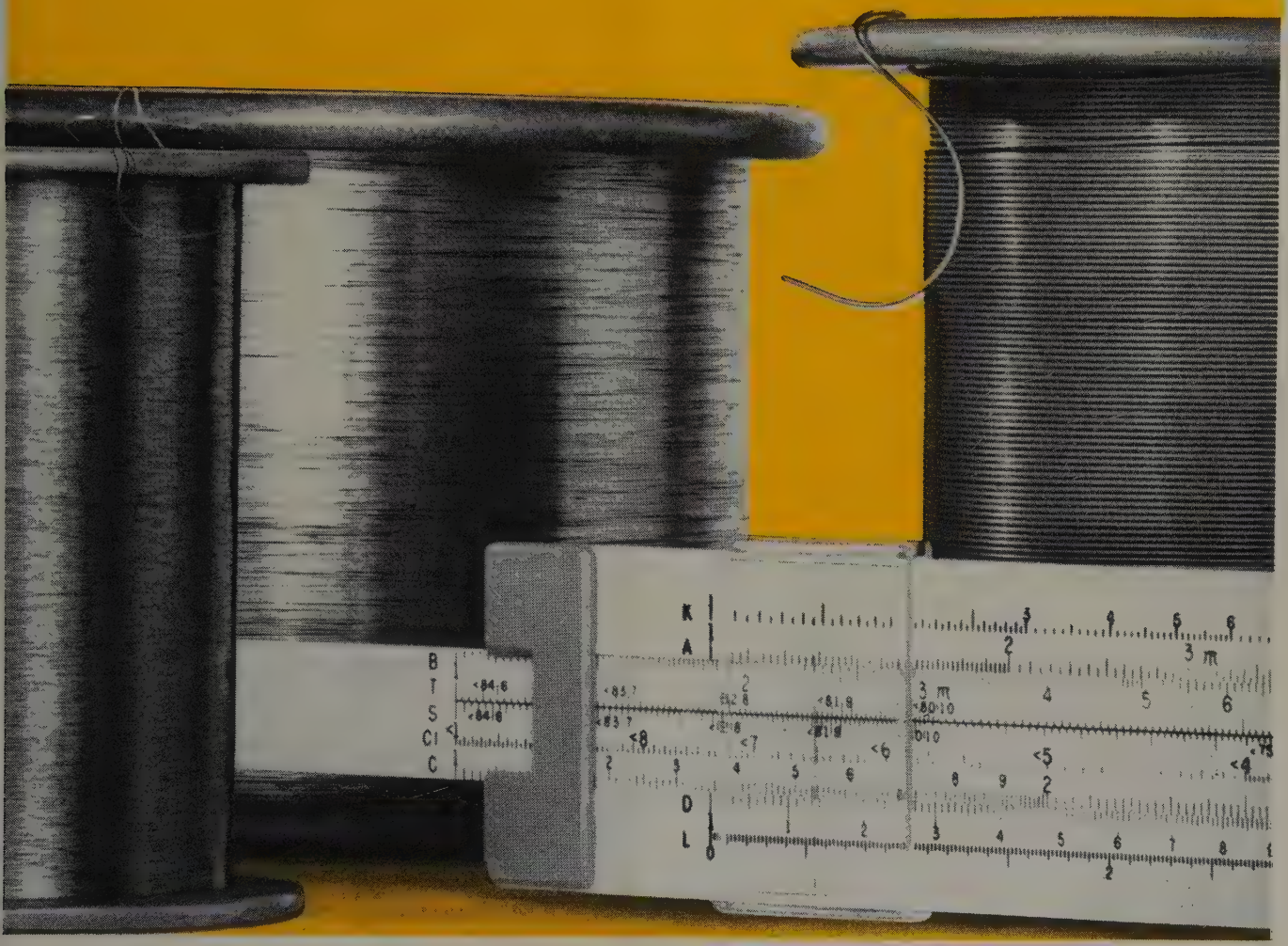
Motor Overload Protection

Heat-sensing switches embedded in stator coils provide overload protection for induction motors. New General Electric Co. "Thermo-Tector" system consists of sealed probes about



2½ inches long extending into windings from the sugar-cube-size, snap-action switches visible in the picture of a stator for a 7½-hp motor. Connected in series with starter contactor coil, they need no amplification.

SYLVANIA MAKES ALL THREE—ALLOY, CLAD AND PLATED WIRE



One way to conserve engineering time

—get an unbiased recommendation on wire from Sylvania

Rapid changes in high-temperature equipment plus the continued evolution in components mean this: it doesn't pay to get mired down by noncreative engineering details. Example: which wire to use to meet conductivity needs in corrosive or oxidizing atmospheres?

To make the most of your engineering time, call on *Sylvania* to help you with wire specs. Sylvania knows wire—and the particular advantages of each kind. Of all major manufacturers, only Sylvania makes all three types of bare wire—alloy, clad and plated. They're available in a complete range of sizes—.002″ to .250″. Each retains optimum characteristics up to recommended operating temperatures.

You know that a Sylvania recommendation will be objective, based on your needs, and not limited by what the supplier can supply. Full details — plus time saving help — are yours when you write Sylvania Electric Products Inc., Parts Division, Warren, Pennsylvania.

SYLVANIA

Subsidiary of **GENERAL TELEPHONE & ELECTRONICS**

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People in the News

Charles A. Trusk has been transferred from the Boston sales office of Continental-Diamond Fibre Corp., Newark, Del., to the New York district. He will be responsible for plastic insulating materials sales in the Hartford, Conn., territory.

Altec Lansing Corp., Anaheim, Cal., has appointed *Ercell B. Harrison* general manager of its Peerless Electrical Products Div., which makes transformers and power supplies. Harrison, who has been with Peerless 20 years, retains his current position as sales manager.

Donald Swindells, previously with Simplex Wire & Cable Co., has been named to handle sales of extruders in the midwest and southwest states for Davis-Standard Div., Franklin Research Corp., Mystic, Conn.

Comco Plastics Inc., Richmond Hill, N. Y., fabricating and extruding division of Commercial Plastics & Supply Corp., has named *Herbert Weil* to represent it in Connecticut. Weil also is general manager of the CP&S sales office and warehouse in New Haven, Conn.

St. Regis Paper Co. has appointed *J. J. Norton,* formerly manager of its Panelyte Div. Industrial Products plant, Trenton, N. J., to the newly created post of manager of marketing and planning for the plant which manufactures industrial plastics.

Henry S. Loeber, formerly Midwest sales manager for Hudson Wire Co., has been named sales manager for Chester Cable Corp., Chester, N. Y., a subsidiary of Tennessee Corp. The company has also named *Benjamin Levinson* as chief engineer. He had been with The Okonite Co.

H. S. Loeber

B. Levinson

T. R. Silk, formerly Newark, Del., plant manager, has been named manager, customer relations at Continental-Diamond Fibre Corp., laminated plastics manufacturer. The firm has also appointed *John F. Rushmore* as manager, sales administration.

At Insulation Manufacturers Corp., *Edward B. Finn* of Cleveland, has been named senior vice president. At the Chicago headquarters, *Bernard F. McNamara* has been appointed executive vice president in charge of IMC's Merchandising Div. *J. Harold Martin* has been named executive vice president in charge of the INMANCO Mfg. Div. with *Stanley W. Jarosz* filling the post of manufacturing vice president, and *Stephen L. Kubala* has been appointed assistant treasurer of IMC, while *Paul K. Wolfram* of Cleveland has been named sales manager.

The Macallen Co. Inc., Newmarket, N.H., mica producer, has appointed *William H. Banks Jr.* executive vice president in charge of the Newmarket operations, and *Richard S. Thayer* and *Charles R. Brothwell* as vice presidents in charge of purchasing and sales respectively.

Board Products Sales headquarters of West Virginia Pulp and Paper Co., insulating paper manufacturer, have been moved from New York to Covington, Va. In the same change, *Carl J. Reyns* has been promoted to manager of board sales replacing recently retired *F. W. Lawson Jr.*

C. J. Reyns

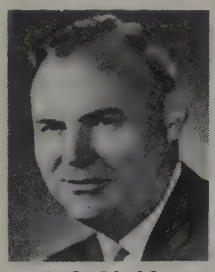
P. J. LaMarche

Paul J. LaMarche, with the company since 1949 and formerly director of production, has been made vice president of production for U. S. Industrial Chemicals Co., Div. of National Distillers and Chemical Corp., New York, polyethylene producer.

At the research laboratory of Allied Chemical Corp.'s General Chemical Div., Morristown, N. J., *Otto G. Direnga*, for the past two years director of planning research, has been named director of research administration. *Walter G. King Jr.* succeeds Direnga as director of planning research. He previously was assistant director, a post now assumed by *Charles D. Boyer Jr.*, formerly manager of engineering research.

At Rea Magnet Wire Co. Inc., Div. of Aluminum Co. of America, Ft. Wayne, Ind., *Robert L. Whearley*, formerly executive vice president, has been elected president. *Allen C. Sheldon*, previously vice president, operations, and secretary, has been elected executive vice president. *Ira M. Belcher*, formerly assistant treasurer and comptroller, has been elected secretary-treasurer. *George T. Cook*, previously assistant secretary-treasurer, has been elected comptroller and assistant secretary-treasurer. And *James L. McKinley*, who joined Rea in 1957 as general sales manager, has been elected vice president, sales.

R. L. Whearley



A. C. Sheldon

I. M. Belcher

J. L. McKinley

At Hooker Chemical Corp., Niagara Falls, N.Y., *Dr. Chris A. Stiegman*, formerly director of research, has been elected vice president, research and development.

At the Bell & Howell Research Center, Pasadena, Cal., *Robert F. Cummings* has been appointed manager of administrative services, and *Frank B. Wiens* has been named manager of engineering services.

Eugene A. Fischer has been appointed sales manager of refractories by Norton International Inc., Worcester, Mass., while *Gale W. Bennett* has been named assistant manager of product engineering in the Refractories Div. *James L. Miller*, refractories engineer in Chicago, has been assigned to the San Francisco area. He will be succeeded in Chicago by *John A. Trogolo*, who has been a product engineer in Worcester. *Robert T. Hale* has been appointed a refractories engineer in Indianapolis.

Robert R. Thek has been appointed director of marketing research, Riegel Paper Corp., New York.

D. L. Harris III has been appointed to the Washington, D. C., Technical Research Div. staff of The Electro Nuclear Systems Corp., Minneapolis scientific firm.

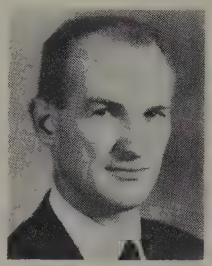
Formica Corp., Cincinnati laminated plastics producer, has named *Dr. John F. Nobis* director of product planning and *William O. Hess*, intercompany technical coordinator.

Keystone Electronics Co. Inc., Newark, N. J., has elected *Adolph M. Gross* president.

At Rochester, Mich., *George E. Bee* has been re-elected president, and *G. Kent Rosenqvist*, vice president of Dytronics Inc., die stamped circuit manufacturing subsidiary of Taylor Fibre Co., Norristown, Pa. At Norristown, *Harry L. Hildebrand*, formerly manager of the fabricating division, has been named manager of process and design engineering. *John G. Musselman* succeeds Hildebrand.

G. E. Bee

G. K. Rosenqvist



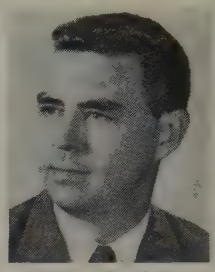
J. G. Musselman

H. L. Hildebrand

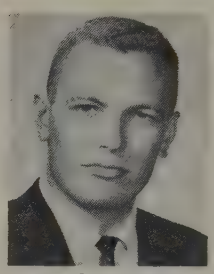
Hercules Powder Co. Inc., Wilmington, Del., has elected *Elmer F. Hinner*, general manager of the cellulose products department, a vice president. He is succeeded by *Werner C. Brown*, previously assistant general manager, who in turn is succeeded by *Paul L. Johnstone*, who has been director of development for the department. *Charles A. Grant* has been named director of sales of the Virginia cellulose department and *Arloe R. Olsen* has been named assistant director of sales. *Richard J. Both* has been appointed assistant general manager of the Virginia cellulose department. *E. Langford Jones* has been named assistant general manager of the synthetics department.

The laminated products department of General Electric Co., Coshocton, Ohio, has appointed *Robert W. Bowers* as Midwest industrial sales representative in Chicago for its line of "Textolite" laminated plastics. The silicone products department of General Electric Co. in Waterford, N. Y., has named *Robert L. Daileader* sales representative in Bridgeport, Conn., *James S. J. Berray*, a sales representative for the Eastern district in Drexel Hill, Pa., *Lawrence D. Stoddard*, a sales representative for the East Central district in Cleveland, and *Parker C. Finn*, a sales representative for the Eastern sales district in Newark, N. J.

J. Berray



R. Daileader



L. Stoddard

P. C. Finn

Bernard J. Warren has been named manager of development engineering for the Atlee Corp., Waltham, Mass., electrical and electronics manufacturer.

A. P. Pitzl has been promoted to assistant general manager of Aemco Inc., Mankato, Minn., electronics manufacturer.

Norton C. Wheeler Jr. has been named research and development manager of Davis-Standard, Div. of Franklin Research and Development Corp., Mystic, Conn., plastics extrusion machinery manufacturer.

N. C. Wheeler Jr.

S. G. Richards

Stephen G. Richards has been named president of Zoron Inc., a newly formed manufacturer of switches and connectors in Chicago.

The Electronic Tube Corp., Philadelphia, has named *Joseph P. Gordon*, formerly with Allen P. DuMont Labo-

ratories, vice president, Cathode Ray Tube Div., and *Charles A. Vaccaro* has been appointed senior project design engineer of the Instrument Div.

Jefferson Craig has been named manufacturing engineer, and *Edward F. Mitchell* has been appointed plant engineer at Keasbey & Mattison Co., Ambler, Pa., manufacturer of asbestos electrical insulation.

Robert J. Leander has been elected president of Mystik Adhesive Products Inc., Chicago tape manufacturer, succeeding *Russell J. Leander*, founder, who has been elected chairman of the board. *Robert D. Smith* has been named executive vice president.

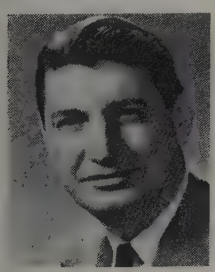
Robert Leander

D. A. Forbes

Donald A. Forbes has been named chief development engineer in the ceramic department of the Electrical Products Div. at Corning Glass Works, Corning, N.Y.

Lloyd C. Graham has been named regional sales manager in 11 Western states for Devcon Corp., Danvers., Mass.

C. K. Jones has been named manager of manufacturing for Hoover Electronics Co., Timonium, Md.



C. K. Jones

Juls Miller

Dr. Juls Miller has been named head of the electromagnetic devices department, Schaevitz Engineering, Pennsauken, N. J.

Joseph P. Foley has been named marketing manager for the Electronics Div., Van Norman Industries Inc., Manchester, N. H., instrument manufacturer.

new CEMENT-COATED EPOXY magnet wire makes possible coils

The secret's in the bond strength. Anaconda's new 130 C (class B) cement-coated epoxy magnet wire forms a bond so strong that the coil is completely self-supporting.

Cold, it holds its shape perfectly without ties or braces; hot, it can be removed from the oven at 200 C and dipped in encapsulating materials without deforming or losing its shape. Both ways you save on production costs. The cement can be activated by resistance heating, oven heating or solvent.

The unique Anaconda Epoxy cement coating makes all the difference. It softens just enough to bond each wire in the coil firmly to adjacent wires. The higher the heat (up to 200 C), the stronger the bond—it is a contact bond with minimum flow.

Because of its *inherent dielectric properties* and because of limited flow, the epoxy cement overcoat actually contributes to the electrical strength of windings. Thus, it is often possible to employ cement-coated epoxy film with little or no increase in over-all diameter of the wire.

And here are some other advantages: Anaconda cement-coated epoxy magnet wire won't hydrolize in closed systems because the cement is an epoxy type

This 24" diameter coil wound with 18 pounds of #.064x.130CCHEP rectangular magnet wire, is entirely self-supporting because it's made of Anaconda's new cement-coated epoxy magnet wire. The outstanding bond-strength of this wire is stable at high temperatures, too. Coils can be removed from oven and handled while still hot without danger of deforming—as shown in picture below.

that hold their shape without support ...both cold and hot...even at 200 C

and the base coat is Anaconda's well-proven epoxy enamel. It is completely compatible with standard transformer oils, varnishes, insulation and encapsulating materials you are most likely to use. It's available in all sizes of round, square and rectangular, packed in spools, reels, pails and drums.

For more information about Anaconda cement-coated epoxy magnet wire, contact Anaconda Wire and Cable Company, 25 Broadway, New York 4, New York, Department EFL-2-I.

ASK THE MAN FROM

ANACONDA®

FOR CEMENT-COATED EPOXY MAGNET WIRE 60257

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New Products

For further information on these products print the item number on the Reader Service Inquiry Card on the back cover. Fill out and mail the card—no postage is required. Insulation *will immediately forward your inquiry to the manufacturers concerned so that they can send you more information promptly.*

200°C Silicone-Asbestos Paper

An asbestos and silicone resin paper, with no organic binders of any kind, reportedly is suitable for operation at class C temperatures (over 180°C), and electrical properties are not impaired by exposure to 275°C for 450 hrs. The paper, style #7601S, is available in gauges from .0025" to .0065". Based upon a gauge of 5.5 mils, the paper weighs 26 lbs/100 sq yds. The concentration of the silicone resin impregnation is approximately 60%. Other features reported include tensile strength (5.5 mil paper) of 45 lbs/in in the machine direction and 16 lbs/in in the cross machine direction, tear strength of 100 grams with the grain and 350 grams across the grain, average dielectric strength of 450 vpm, and heat resistance of 200°C continuous. Asbestos Textile Div., Raybestos-Manhattan Inc., Manheim, Pa.

Print No. Ins. 101 on Reader Service Card

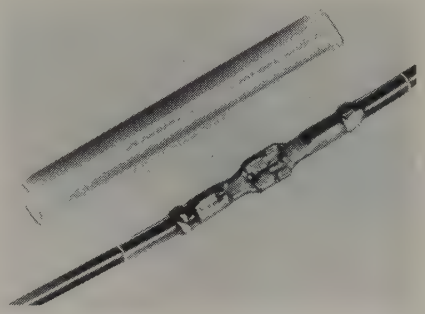
Silicone Fluid Simplifies Potting, Encapsulating of Electronic Units

A "super-thin" fluid silicone rubber that cures without heat promises to simplify and improve potting and encapsulating of electronic units. New "Silastic" RTV 521 reportedly has such a low viscosity that it pours and flows like coffee cream, completely filling narrow channels, fine cracks, and "hard-to-reach" sections of complex parts. Although RTV 521 begins to cure or vulcanize soon after addition of catalyst, it remains in a workable consistency for a few hours. After 24 hrs at room temperature, it is stated to become a moisture-proof, weather-proof silicone rubber with excellent electrical properties. Fully cured RTV 521 is said to remain rubbery from —70 to +500°F (—56.7 to +260°C) and to withstand temperatures up to 600°F (316°C) for short times. It is also claimed that RTV 521 does not corrode, discolor, or react with copper and other metals used in electronic components. Dow Corning Corp., Midland, Mich.

Print No. Ins. 102 on Reader Service Card

Transparent Irradiated Insulation Sleeving that Shrinks to Fit

A new irradiated insulation sleeving, "Thermofit" RF, which shrinks to a smaller and predetermined size when heated, is designed for sleeving applications where an economical high-temperature, clear, transparent, flexible encasing material is required. Temperature range claimed is —67 to +275°F (—55 to +135°C) for continuous operation and as high as



572°F (300°C) for one hour. Properties reported include thermal stability; no cold flow or melting; high dielectric strength; and resistance to abrasion, aviation fuels, hydraulic fluids, acids, and alkalis. In shrinking it conforms readily to complex contours, giving skin-tight encapsulation quickly and easily. Though flammable, it reportedly will not support combustion when shrunk over non-flammable components. Rayclad Tubes Inc., Oakside at Northside, Redwood City Cal.

Print No. Ins. 103 on Reader Service Card

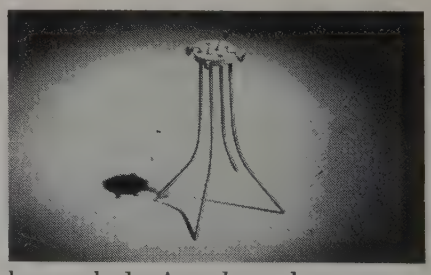
Polyurethane Electrical Sealant Is Tough but Easy to Apply

A polyurethane sealant for a wide variety of uses in the aviation, railway, appliance, and electrical industries is said to offer notable advantages over other sealants and calking compounds. Designated 829-901 black U. I. sealant, the new material is a soft, high-modulus composition which is easily applied with either a calking gun or a knife. A stable, single package material, it reportedly requires no field mixing or curing accelerators, does not shrink on aging, and has excellent adhesive properties that will withstand temperature changes from —75 to +150°C. It is flexible on aging, has good resistance to chemicals, and serves as a barrier protection between dissimilar metals, it is claimed. Manufacturer also states it will not slump or sag in vertical or overhead installations—even in joints as wide as ¾". The film-forming urethanes in the sealant provide a tough skin in one to three days, and the material is completely cured to a durable, elastic rubber in 10 to 14 days. Excellent resistance to water and alkali and to most chemicals, solvents, and corrosive atmospheres is claimed. Industrial Finishes Section, Fabrics and Finishes Dept., E. I. du Pont de Nemours & Co., Wilmington, Del.

Print No. Ins. 104 on Reader Service Card

Glass-Bonded Mica Substrates For Printed Circuits

New substrates for printed electronic circuits consist of small glass-bonded mica slabs with leads molded in position and surfaces lapped to a 10-microinch finish. Another feature is an interlocking device which is molded in so that the substrates may



be stacked. An electro-less process by which copper conductive circuits can be deposited in holes and on surfaces of the glass-bonded mica in layers .0005" thick has been developed. The glass-bonded mica is said to be particularly suitable for sub-

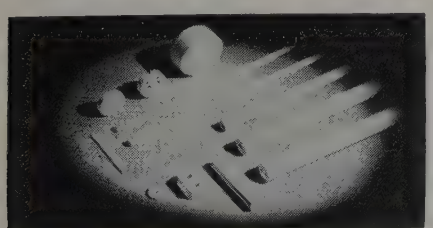
strate applications because of the following features: ultra smooth surface; rigidity (the slightest warpage would reduce circuit reliability and destroy tolerance control in the stacking of several substrates); high resistivity (5×10^{11} ohms per centimeter at room temperature, permitting side by side circuits to retain their integrity). Electronic Mechanics Inc., 101 Clifton Blvd., Clifton, N. J.
Print No. Ins. 105 on Reader Service Card

Improved Polyurethane Insulating Tape Provides Greater Protection

An improved polyurethane foam insulating tape reportedly gives greater protection against heat, cold, shock, vibration, dust, sound, moisture, and electricity. Called "Arnofoam," the tape is available in three thicknesses of urethane foam backing, ⅛", ¼", and ½". The backing is firmly bonded to a strong, moisture-resistant, transparent backing film by a high-tack, transparent, pressure-sensitive adhesive. A continuous high temperature limit of 260°F (127°C) and an intermittent limit of 300°F (149°C) are claimed for the tape. The tape has a wide variety of applications in radio-television, electronics, electrical equipment, cooling, heating, aircraft, automotive, and comparable industries. Arno Adhesive Tapes Inc., Michigan City, Ind.
Print No. Ins. 106 on Reader Service Card

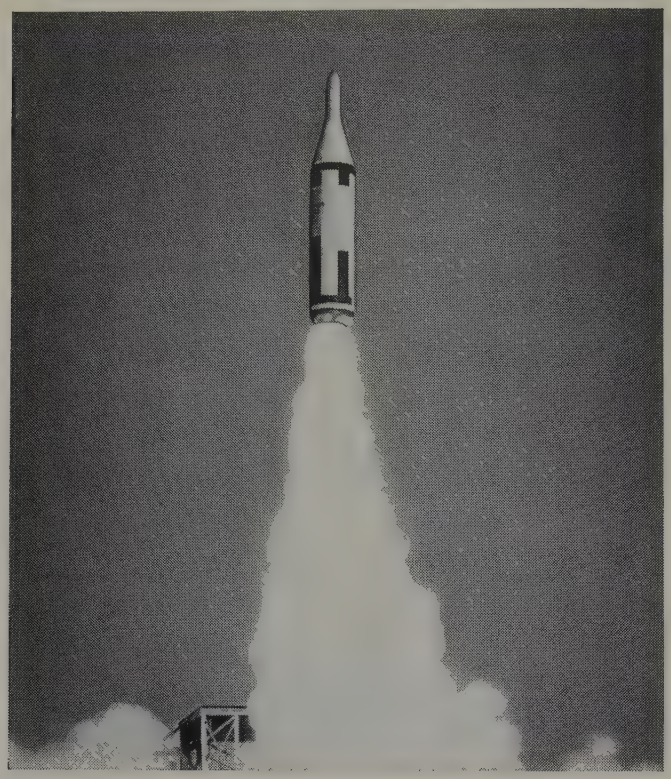
Crushable Ceramic Insulating Tubes

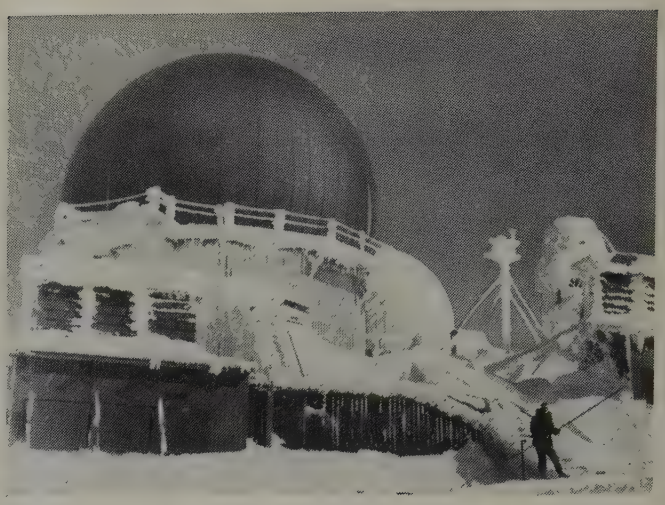
Three crushable ceramics are now offered for use in producing high quality metal sheathed heaters, cables, thermocouples, range units, and other



metal sheathed devices requiring highest quality, accurately spaced insulation. These crushable ceramics include an extremely high purity electrically fused magnesia said to have total impurities of less than 0.7%. Its reported low boron content plus low sulfur, hafnium, and iron make it particularly desirable for insulation of metal sheathed cable, ther-

In Arctic cold...



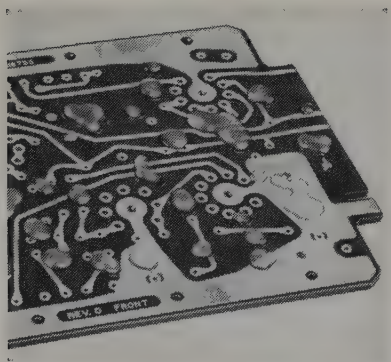


General Electric Silicone Fluids offer reliability from —65°F to 400°F as liquid dielectrics and heat transfer media in aircraft, missiles and ground installations. Excellent dielectric properties are virtually unchanged over wide ranges of temperature and frequency.

or missile heat...

G-E Silicone Rubber Insulation is used in missiles and space vehicles because of its excellent insulating properties, resistance to temperature extremes, moisture and ozone and its long-time stability in storage.

G-E silicone insulations do the job!



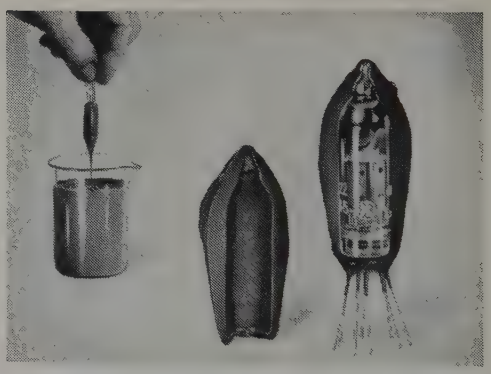
RTV* Liquid Silicone Rubber comes in a wide range of viscosities for potting, encapsulating, impregnating and sealing. RTV resists heat, cold, ozone, moisture; protects against high-altitude arc-over.
*Room Temperature Vulcanizing

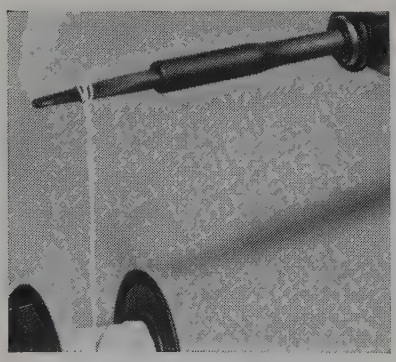
G-E Silicone Varnishes provide excellent protection against moisture and high operating temperatures. Applications include conformal protective coatings for printed circuits, resistor coatings, transformer impregnation, etc. New varnishes cure at low temperatures.

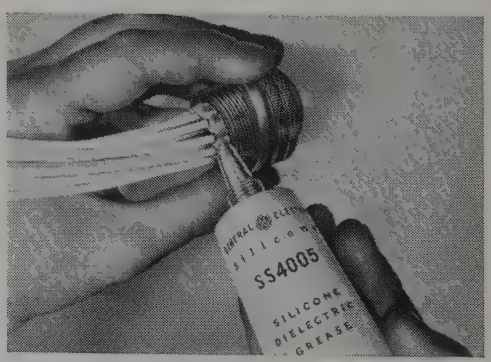
New Silicone Dielectric Greases maintain physical and electrical properties from —65°F to 400°F, offer protection against moisture and oxidation. Used as corrosion inhibitors, lubricants, heat transfer media and release agents.

Silicone Rubber Wire Insulation withstands soldering heat without damage; matches or exceeds vital properties of insulation costing three times as much. Provides long service life at 500°F; momentarily withstands temperatures up to 5500°F. Flexible as low as —150°F, it resists moisture, ozone, nuclear radiation.

Send for technical data, "Silicones-for-Insulation." Section M131, Silicone Products Department, Waterford, New York.







GENERAL ELECTRIC

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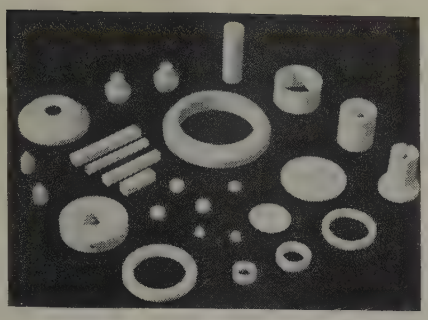
mocouples, and simliar items for atomic energy application. Designated AlSiMag 714, it meets purity requirements of AEC Spec. AEC-Sr-10(ORO) and KAPL Spec. O-KPM 7-1. These crushable ceramics are normally furnished as tubes 1″ to 4″ long, and with holes to fit the wires or rods to be insulated. Swaging reportedly results in a dense, accurately positioned and uniform ceramic insulation with high electrical resistivity at elevated temperatures. American Lava Corp., Manufacturers Rd., Chattanooga 5, Tenn.

Print No. Ins. 107 on Reader Service Card

Aluminum Oxide Ceramics For Extreme Heat and Wear

A new line of ceramics designated HT-1 series is said to have heat resistance to 3000°F, hardness in the range of carbides, and dielectric strength as high as 250 vpm. They are high aluminum oxide ceramics, and are available in three grades: HT-1-A, best for high wear and moderate heat shock; HT-1-B, best for high heat shock and moderate wear; and HT-1-C, best for extreme wear



and moderate heat shock. The HT-1 series reportedly offer a remarkable combination of properties including compressive strengths to 400,000 psi, heat resistance, wear and corrosion resistance, and non-magnetic and dielectric properties. HT-1 parts can be metalized for soft or hard soldering, or fastened with ceramic and epoxy cements. Duramic Products, Inc., 426 Commercial Ave., Palisades Park, N.J.

Print No. Ins. 108 on Reader Service Card

Improved Thermal Curing Silicone Rubber Cement

An improved adhesive system for bonding silicone rubber to itself or silicone rubber to glass, "Dacron," and nylon fabrics may also be used for bonding silicone rubber to metal, plastics, glass, and ceramics with the aid of a primer. Improved "COHR-lastic" C-251, a silicone rubber thermal curing cement is said to have an effective temperature range from —100 to +500°F (—73.3 to +260°C). Bond strengths vary from 8 to 15 psi peel strength depending upon the formulation of the silicone rubber to be cemented. This material cures under heat and pressure to form a tough yet flexible bond. Advantages claimed are better handling, quicker curing, and less sensitivity to adverse conditions of bonding. Connecticut Hard Rubber Co., 407 East St., New Haven 9, Conn.

Print No. Ins. 109 on Reader Service Card

Epoxy Potting Compound

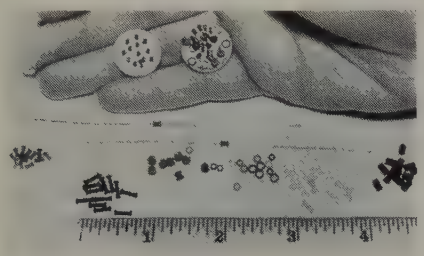
A new epoxy compound, Wright #1201, is designed for potting electronic assemblies, motors, synchros, transformers, and any other components that might be sensitive to the usual stresses that occur during the cure of a resin. Wright #1201 reportedly cures with negligible shrinkage and internal stresses, has

thermal shock range of —100°C to +180°C, is easily handled (two components in a 1:1 ratio), and is nontoxic. One-quart trial samples available at $6.25. Wright Plastics Inc., 114-13 Atlantic Ave., Richmond Hill, N.Y.

Print No. Ins. 110 on Reader Service Card

Microminiature Insulation Parts Machined from Cast Epoxy Rods

A complete line of miniature and microminiature resistor bobbins, coil forms, and encapsulating cups are said to have excellent electrical, mechanical, and chemical properties. Resistor parts are stated to be mass-



produced with extreme accuracy and uniformity in sizes as small as 1/32" OD and 1/32" in length, to wall thicknesses of .004". Bobbins, coil forms, and cups are machined from high strength cast epoxy rods. Omega Precision Inc., 755 N. Coney Ave., Azusa, Cal.

Print No. Ins. 111 on Reader Service Card

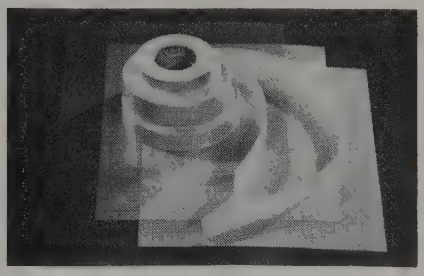
Dielectric Coating for Metals, Wood, Plastics

A new clear and transparent resin coating is said to have a dielectric strength of 2500 vpm. It reportedly provides exceptional but relatively inexpensive circuit board protection, may be used on aluminum in place of anodizing, and can be applied to wire with heat-accelerated drying. PT-425 resin can be applied with conventional spray equipment, cures readily with short bake, and parts coated on the job will dry sufficiently in a half hour to allow handling. Excellent adherence to metal, plastics, and wood; excellent resistance to weathering, impact and abrasion; ability to withstand salt spray more than 1000 hours; ultraviolet resistance; no chalking; and a temperature range of —65°F to +300°F (—53.9°C to +260°C) are claimed. Product Techniques Inc., 511 E. 87th Place, Los Angeles 3.

Print No. Ins. 112 on Reader Service Card

Flexible Epoxy-Glass Insulation For Class F Uses

A new epoxy-glass insulating material reportedly retains its high dielectric strength and flexibility under continuous class F temperatures. Called "Irvington" brand epoxy coated glass No. 2525, the material is said to be compatible with all class



F magnet wires and most epoxy systems, and will not contaminate or degrade transformer oils used in distribution transformers. It is also claimed that the epoxy coated glass is flexible, conforms snugly on application, and does not discolor after heat aging. Applications include insulation in encapsulated transformers; phase, slot, and coil insulation in class F motors or in encapsulated motors; interlayer insulation in oil immersed distribution transformers or in class F air-cooled distribution transformers; slot, phase, coil, and interlayer insulation on military units designed for short term operation at class H temperatures and for all other class F components, as well as any form of epoxy cast, impregnated, or encapsulated units. Dept. WO-442, Irvington Div., Minnesota Mining and Manufacturing Co., 900 Bush Ave., St. Paul 6, Minn.

Print No. Ins. 113 on Reader Service Card

Potheadless Terminations For 5 KV Paper-Lead Cables

Cable accessory kit #705 for making hermetic potheadless terminations on 5 kv paper-lead cable for both indoor and outdoor service is said to

offer considerable cost savings to utilities. Cable is prepared in the normal manner. Stress cone may be omitted. A laminate of special epoxy resin and "Orlon" tape is then constructed by simple, brush-on technique. Laminate extends from lead sheath to terminal ferrule, providing a positive oil-tight, moisture-tight, weather-proof termination. Free specification sheet. The Epoxylite Corp., 1428 North Tyler, South El Monte, Cal.

Print No. Ins. 114 on Reader Service Card

Identification Markers for Sub-Miniature Components

A new self-adhering marker is designed to identify miniature and subminiature components on matrix boards and circuit cards. Any combination of numbers and/or letters can be supplied on a marker by a printing process said to provide tiny but clear, sharp type permanently legible on a marker 1/16" x 3/16" size. Marker material is resistant to various solvents and chemicals and complies with applicable portions of MIL-I-15024A. Free samples and

ANACONDA uses covering of

TENITE POLYETHYLENE

for this lightweight, durable line wire...

By covering this ACSR line wire with Tenite Polyethylene, Anaconda meets the needs of both lineman and engineer.

To the lineman, this covering means wire that is especially easy to handle—light in weight, fast stripping and flexible even at low temperatures. Its sleek finish creates no pulling problems.

The engineer appreciates its resistance to weather, abrasion and heat, its good dielectric strength and freedom from festooning. With insulation of tough Tenite Polyethylene, a smaller diameter is made possible which offers less area for wind resistance and ice loading. Also, the lighter cable permits wider pole spans.

Tenite Polyethylene, an Eastman plastic, is easily extruded as jacketing or primary insulation for many diverse applications, from coaxials to control cables, from TV lead-ins to telephone wires. For high-frequency service, where a very low dielectric constant is needed, this versatile material may be "foamed," with a resulting dielectric constant as low as 1.5.

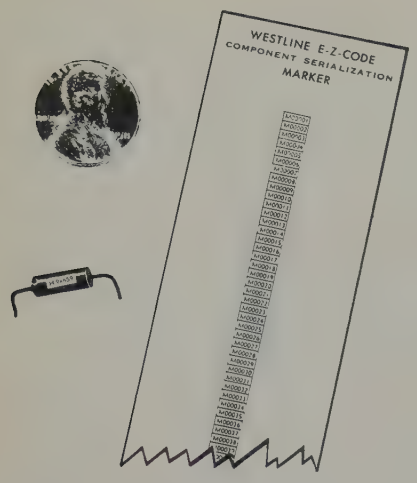
Leading wire and cable manufacturers throughout the country are now using Tenite Polyethylene as jacketing and insulating material. For further information, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

TENITE®

POLYETHYLENE

an Eastman plastic

- *Line wire manufactured by Anaconda Wire and Cable Company, 25 Broadway, New York 4, N. Y. Covering extruded of Tenite Polyethylene.*
- *Both natural and black electrical grade Tenite Polyethylene are available to cable manufacturers in a unique spherical pellet form which flows freely in the extrusion process and in "air-veying" of bulk shipments from truck to bin.*

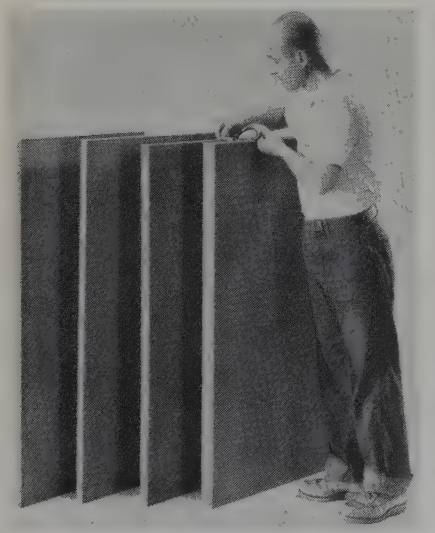


literature available. Westline Products, Division of Western Lithograph Co., 600 E. 2nd St., Los Angeles.

Print No. Ins. 115 on Reader Service Card

Large Nylon Plate

Nylon plate in 2 ft widths and 4 ft lengths in thicknesses of ½″ through 4″ is now available. The plate is made of MC nylon, a formulation produced by new processing techniques. Prices



are said to average 15% below plate of types 6/6 and 6 nylon. Tubular bar and rod up to 17″ outside diameter are also available in the new formulation. The Polymer Corp., Reading, Pa.

Print No. Ins. 116 on Reader Service Card

Non-Burning Epoxy-Glass Laminate

"Micaply" grades EG-818 (unclad) and EG-818-T (copper clad) are said to be "non-burning" when tested in accordance with ASTM D635. These epoxy-glass laminates reportedly meet MIL-P-18177B (type GEE), MIL-P-13949B (type GF), and NEMA grade FR-4 (proposed). Grade EG-818-T is an all-purpose laminate which can be dip-soldered and/or electroplated, and/or vapor degreased without detrimental effect. No adhesive is used to achieve the excellent bond strengths available in this grade. Technical data sheets available. The Mica Corp., 4031 Elenda St., Culver City, Calif.

Print No. Ins. 117 on Reader Service Card

Solvent Release for Sticky Molding

New mold release, called "Mold Wiz Azn," is a solvent type reported to have exceptional efficiency for "sticky" plastic applications such as epoxy and isocyanate molding operations, including fiber glass-epoxy and isocyanate foams of all types. Technical data and free samples available. Axel Plastics Research Laboratories, 1070-72 Manhattan Ave., Brooklyn 22, N.Y.

Print No. Ins. 118 on Reader Service Card

High-Temperature Laminate For Missile Applications

A new high-temperature industrial laminated plastic, Grade AA-HT, has an asbestos woven fabric reinforcement and a modified phenolic resin binder, and features high bond strength, good machinability, and good dimensional stability when exposed to moisture. It is recommended for continuous exposure up to 500°F. Laboratory tests reportedly indicate that this material retains 40% of its mechanical strength after exposure to 500°F for 1,000 hours. Applications are expected to include uses in the general field of missiles. Synthane Corp., Oaks, Pa.

Print No. Ins. 119 on Reader Service Card

Silicone Adhesive Speeds Motor Insulation

A new rubbery silicone adhesive provides a fast method for insulating "sore thumb" connections in form wound motors. The procedure is to fill molded silicone rubber connector caps with "Silastic" RTV 731, a ready-to-use, room-temperature-vulcanizing silicone rubber that is simply squeezed from its collapsible tube. Filled caps are installed over each coil connection. Within 24 hours the RTV cures to a rubbery solid and be-

comes an integral part of sealed silicone rubber insulation systems. Dow Corning Corp., Midland, Mich.

Print No. Ins. 120 on Reader Service Card

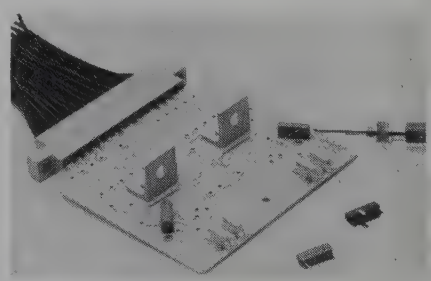
Transparent Epoxy Castings in Flexible, High-Impact, or Rigid Forms

Completely transparent castings can be made from crystal-clear "Maraglas" epoxy resin in flexible or high-impact as well as rigid forms. The choice of desired characteristics is made possible by improved processing methods based on the development of special new hardeners. No vacuum equipment or other complex apparatus is needed. After a cure of several hours at 180 to 210°F, the cured casting is said to have 90% light transmission and to exhibit a smooth, hard, bubble-free, non-tacky surface that does not crack or craze and that resists distortion even when exposed to extremes of temperature or humidity. Marblette Corp., 37-31 Thirtieth St., Long Island City 1, N.Y.

Print No. Ins. 121 on Reader Service Card

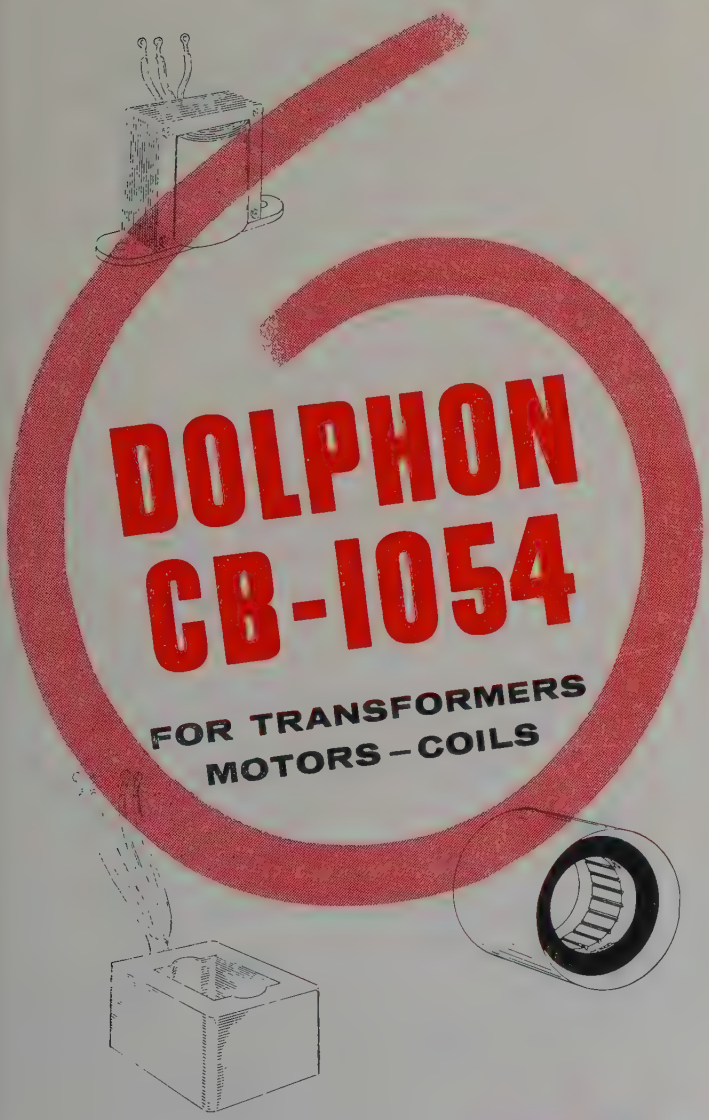
Printed Circuit Board Test Probe Receptacle

A new test receptacle will receive the standard .080 test probe used with ammeters, voltmeters, ohmmeters, and other test equipment to test printed board circuits without interrupting operating currents. Each receptacle is available with two or three-leg mount. Leg mounts are V-shaped to promote



IT'S HERE!

a flexible epoxy resin



Now you can quickly and easily encapsulate and impregnate your transformers, motors and coils, getting the flexibility and penetration you need and want with Dolphon CB-1054 epoxy resin.

This "easy-to-apply" general purpose resin, which meets the requirements of MIL-T-27 for class B insulation, has excellent flexibility and extremely low viscosity. It provides a quick cure at moderate temperatures and has an extended pot life of four to six weeks.

CB-1054 is a two-part resin that is mixed by one to one weight ratio. Both parts are very stable and completely deaerated.

You will find CB-1054 competitively priced with other resins not having these product advantages!

CHARACTERISTICS

CURE		VISCOSITIES & POT LIFE		
HRS.	TEMP. °F	°F	CPS.	POT LIFE
8-12	225	75	8000	4 to 6 Wks.
5-8	250	110	2000	30 to 36 Hrs.
3-5	275	130	1200	10 to 12 Hrs.
—	—	150	950	6 to 8 Hrs.

SPECIAL OFFER

A 2 lb. sample of CB-1054 (1 lb. each of parts A and B) is available to you at the low trial sample price of $3.50. Send for yours today.

Dolph's®

JOHN C. DOLPH COMPANY

INSULATING VARNISH SPECIALISTS

MONMOUTH JUNCTION, NEW JERSEY

Licensees: England: The Walpamur Co. Ltd., Darwen, Lancashire • **Italy:** Societa Albesiano, Moncalieri (Torino) • **Canada:** Crown Diamond Paint Co. Ltd., Montreal • **Chile:** Sociedad Quimica Nacional "Soquina", Santiago

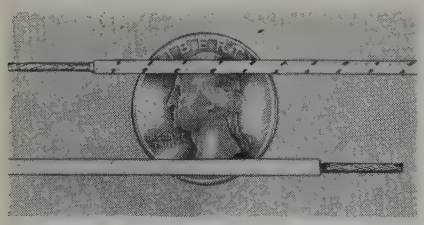
Print Ins. 36 on Reader Service Card

solder wicking, will hold the receptacle in place from assembly to soldering. Three-leg mount increases stability; all mounting is done at the end of the board. Two-leg mount permits positioning anywhere on the card, closer spacing. Receptacle is double ended for either-end probing. It has a formed barrel and is recessed into the housing to prevent shorting or flash over. Housing which contains the receptacle is "Zytel" nylon 101 and is rated for 105°C. AMP Inc., Harrisburg, Pa.

Print No. Ins. 122 on Reader Service Card

Satellite Wires Resist Radiation

Two miniature versions of a 1000°F "Super Jet" instrument wire have been developed especially for satellite use. Both are highly radiation resistant. Style 1 (top) is for use in

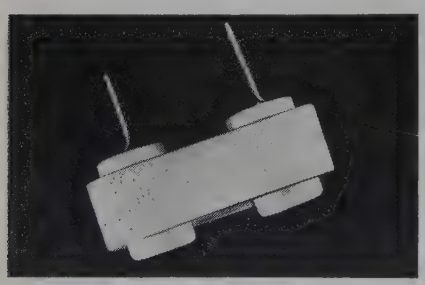


sealed capsules. Style 2 (bottom) withstands an environmental dielectric test of 1500 v after 90 days immersion in tap water, indicating prelaunching stability. Boston Insulated Wire & Cable Co., 25 Bay St., Boston 25, Mass.

Print No. Ins. 123 on Reader Service Card

Space-Savings, Non-Breakage For "Teflon" Crystal Sockets

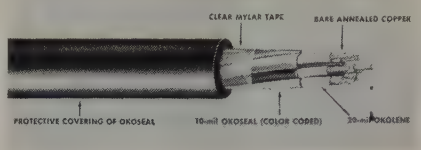
New sub-miniature, low loss crystal sockets are designed to conserve space in wire or printed circuit applications. A Teflon body is claimed to virtually eliminate the danger of breakage during assembly operations as encountered with ceramics. The sockets are designed for use wherever low loss, frequency stability, and mechanical shock and vibration are problems. Garlock Electronic Products, Garlock Inc., Camden 1, N.J.



Print No. Ins. 124 on Reader Service Card

Small Diameter Plastic Control Cable

New small-diameter, plastic "Okonite P-30," general purpose control cable for utilities and industries is suitable for all types of installations: conduit, aerial, duct, tray, and direct

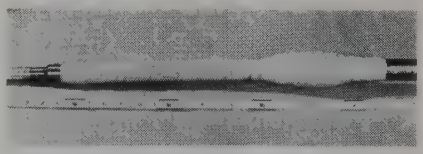


burial—in wet or dry locations. It is said to be more than 30% smaller and lighter than conventional rubber cable, yet to offer advantages similar to those normally associated with those cables. Multi-wall construction provides three-fold electrical protection since the basic conductor insulation, its protective covering, and the overall jacket are all high quality dielectrics. Cable is recommended particularly for d-c circuits in wet locations and for temperature ranges to 75°C. Bulletin 1140 available. The Okonite Co., Subsidiary of Kennecott Copper Corp., Passaic, N.J.

Print No. Ins. 125 on Reader Service Card

Kit for Making Hermetic Seals In Cable Pothead Terminations

Cable accessory kit #735 for making hermetic oil-seals in pothead terminations for paper lead cable operating in the 23-35 kv range is stated to provide simplified installation and reduced maintenance costs. The cable is prepared in the normal manner, with construction of conventional stress cone. Over this, a laminate of

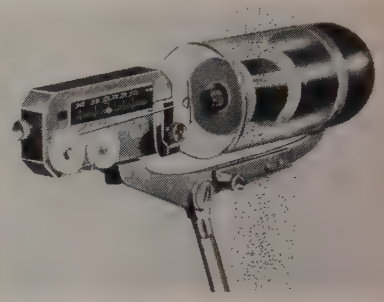


special epoxy resin and "Orlon" tape is constructed. Laminate extends from the lead sheath to the terminal ferrule, providing a positive oil and moisture-tight hermetic seal. After construction of the epoxy-Orlon laminate, the pothead is applied and is nearly filled with oil, leaving a small space for expansion and contraction. Hermetic seals constructed in the above manner have been subjected to over-voltage tests that reportedly establish a life expectancy in excess of 100 years. The Epoxylite Corp., 1428 North Tyler Ave., South El Monte, Calif.

Print No. Ins. 126 on Reader Service Card

Constant Tension, Calibrated Wire De-reeler

A new calibrated tension takeoff for coil winding and wire spooling machines reportedly permits small and ultra-fine diameter wires to be de-reeled and made up into virtually perfect coils. Said to be the only device of its type, this patented "Meteor" wire pay-off maintains a

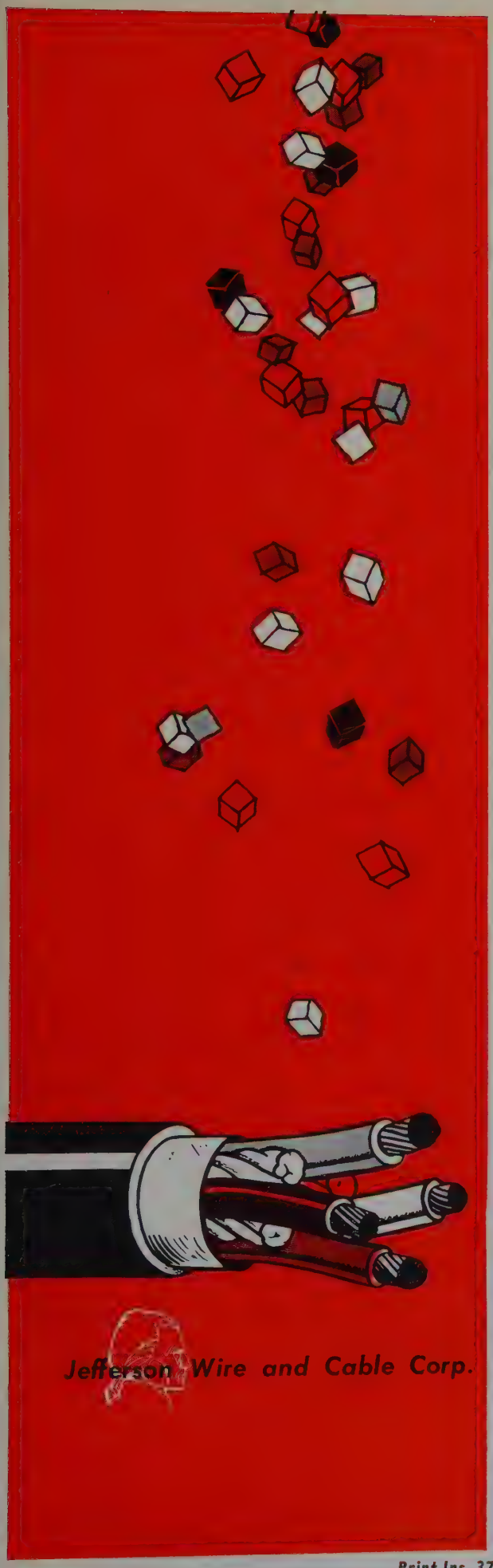


uniform predetermined tension at high winding speeds even when speed varies. With the new unit, it is claimed, any winding machine can be started with full acceleration and stopped abruptly without breaking the wire or affecting tension settings. Associated American Winding Machinery Inc., 750 St. Ann's Ave., New York 56.

Print No. Ins. 127 on Reader Service Card

Retractable Cord and Reel

A new development in retractable cord and reels eliminates all brushes or other friction contacts. It is designed for use in low level circuits where contact resistance variation cannot be tolerated. Each conductor is continuous from end to end, and the number of conductors is limited only by the allowable diameter of the cable. The Morey Corp., 2014 North



HOW TEAMWORK INTRODUCED A NEW SHAPE IN VINYL COLOR CONCENTRATES

Jefferson Wire and Cable Company, Sutton, Mass., a fast growing wire manufacturer, who prides itself on the fact it can supply 1,000 or 1,000,000 feet of wire with the same degree of service and quality, approached the Blane Corporation with a problem regarding uneven color dispersion caused by powdery deposits found in granular type color concentrates.

Jefferson knew that Blane was doing work in the area of developing vinyl color concentrates utilizing pellets in place of a granular product, and requested a product that would meet the following requirements:

1. *Be free from fines and powdery deposits*
2. *Have full color strength–in a range of NEMA colors*
3. *Have good electrical properties*
4. *Give a smooth, streak free extrusion*
5. *Have greater over-all economy*

The result is Blane vinyl color concentrates — a uniform size pellet which gives even, rapid and full color dispersion under heat. Blane pelletized color concentrates, when tumbled with natural, pelletized vinyl compounds, will result in a smoother, streak free extrusion with no plant dusting problems.

This is another example of industry teamwork in action. We, at Blane, will be pleased to work with other wire and cable manufacturers in the areas of special colors, custom compounds for specialized requirements or current or long term insulation problems.

Blane

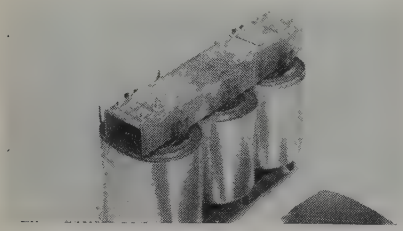
THE BLANE CORPORATION
CANTON, MASSACHUSETTS

Print Ins. 37 on Reader Service Card

Major Ave., Chicago 39.
Print No. Ins. 128 on Reader Service Card

Thin Film Anodic Aluminum Oxide Insulation on Wire and Strip

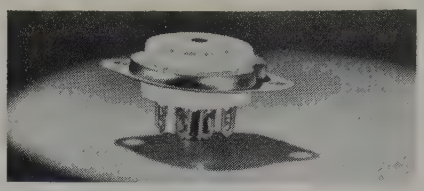
Aluminum oxide insulation is said to have a melting point of 3600°F and a voltage breakdown of about 30 to 40 v per micron MM (.00004″), to resist nuclear and neutron radiation and gamma rays, and to be chemically inert. The film reportedly is highly flexible and can be continuously bent around a wire three to four times its own diameter. Thickness can be controlled from about .00007 to over one mil. Aluminum wire or strip with "Permaluster" new improved flexible aluminum oxide insulation is about half the weight for the same capacity as copper. It has been tested in coils, cable, lead wire,



motors, solenoids, transformers, nuclear pumps, capacitors, transducers, etc. Permaluster Inc., 2012 W. Burbank Blvd., Burbank, Calif.
Print No. Ins. 129 on Reader Service Card

Small Tube Sockets of "Teflon" FEP And Chlorotrifluoroethylene for HF

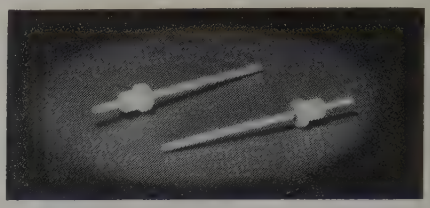
A new series of "Chemelec" 7- and 9-pin miniature tube sockets are designed for high frequency service in electronic equipment where low loss factor and dielectric constant are required. The body insulation is "Teflon" FEP or CTFE (chlorotri-



fluoroethylene). These materials are said to be excellent for high frequency, high temperature, and high voltage service. They reportedly will not carbonize under arcing and will not d-c plate. Garlock Electronic Products, Garlock Inc., Camden 1, N.J.
Print No. Ins. 130 on Reader Service Card

Sub-miniature "Teflon" Feedthrough With Extra-Long Pin

The significant feature of a new insulated feedthrough (FT-SM-16L6) is an extra-long pin combined with a small diameter Teflon body for space-saving on the mounting chassis. The

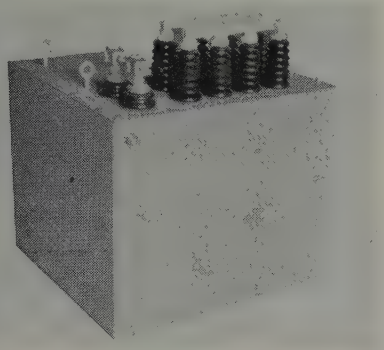


overall length is .987″, while the Teflon body is .093″ diameter through-chassis and .125″ diameter through mounting shoulder. Sealectro Corp., 610 Fayette Ave., Mamaroneck, N.Y.
Print No. Ins. 131 on Reader Service Card

Versatile High-Voltage A-C Test Set

A two-piece, high-voltage a-c test set designed for dielectric strength testing and conforming to ASTM specifications features a 4-coil HV secondary enabling the user to obtain full rating at ¼, ½, and full output voltage. Other standard features in-

clude motorized control for continuously adjustable output from zero to ¼, ½, or full voltage; multi-scale output metering of voltage and current; low waveform distortion; and

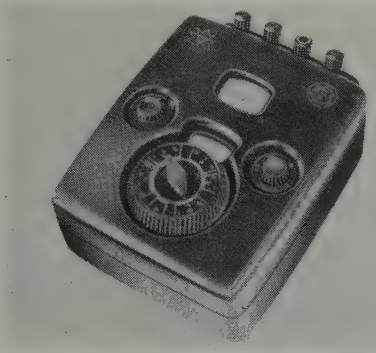


full set of safety and convenience controls. Unit pictured is model K25-50AC, with a maximum output of 25 kv rms, and 50 kva capacity. Other sizes are available. Applications include the use by wire and cable manufacturers for full reel testing of cables, and for general dielectric strength testing of highly capacitive loads requiring high kva capacity test sets. Peschel Electronics Inc., Towners, Patterson, N.Y.

Print No. Ins. 132 on Reader Service Card

Bridge for Measuring Resistance, Inductance, and Capacity

The Metrapont-bridge for measuring resistance, inductance, and capacity employs a classical Wheatstone bridge circuit which functions in the conventional manner when measuring d-c, and is connected to a transistor amplifier with phase comparison for a-c measurements. The unit

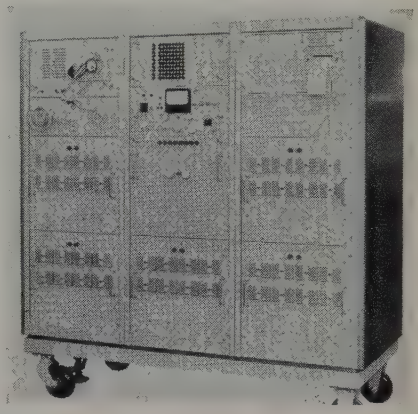


features d-c resistance measurements of 0.05 ohms to 50,000 ohms; a-c measurements of 50 ohms to 5 megohms; capacity measurements of 5 PF to 50 microfarads, 50 henries; and is capable of comparison tests when used in conjunction with external R, L, and C standards. Price is $199. Physics Research Laboratories, Uniondale, L.I., N.Y.

Print No. Ins. 133 on Reader Service Card

Tape-Programmed Cable Harness Analyzer

New model 230 tape-programmed cable harness analyzer features programmed continuity, leakage from wire under test to all other wires, complete random selection, 100% branch testing capabilities, search scan, and fault print-out. The search scan feature of this equipment permits rapid location of all existing faults by holding one end of the wire under test, while scanning all

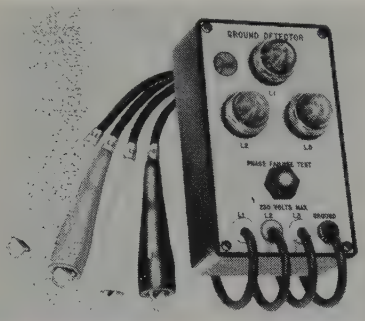


others. The printer prints the number identifying all faults connected to the wire under test. California Technical Industries, Division of Textron Inc., 1421 Old County Rd., Belmont, Calif.

Print No. Ins. 134 on Reader Service Card

Portable Ground Detector

A new portable ground detector indicates leakage and grounds on normally underground power systems. The compact instrument, designated model MP2, reportedly will detect any ground fault from zero resistance to as high as 50,000 ohms and indicate in which phase the fault occurs, and will provide positive indication on any 2 or 3-phase system

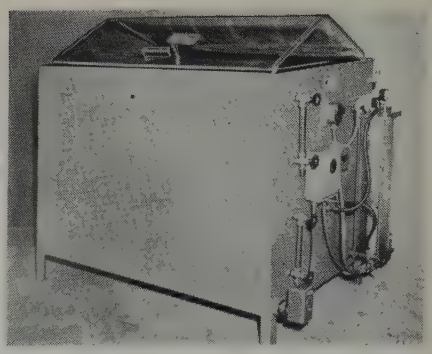


from 105 to 480 v without switching. A test circuit permits intentional grounding, through a resistor, of each successive phase. Connections are made by means of four 36" oil-resistant, rubber-covered test leaks with insulated clips. Dimensions are 6¼" x 3¾" x 3¼". Weight is 30 oz. Price is $25 net FOB factory NYC. Opad Electric Co., 43 Walker St., New York 13.

Print No. Ins. 135 on Reader Service Card

Steel Corrosion Test Cabinet

New G-S corrosion test cabinet for salt, Corrodkote, and humidity tests features improved test conditions and results and meets ASTM and US Government specifications. Available in 110 v or 220 v/single phase/3.5 kw, or (optional) 220 v, 440 v, or 660 v/3 phase/with 110 v control. The cabinets are either stainless or mild steel, all-welded, epoxy lined, and uniformly heated throughout by full-coverage water jackets on all four sides and bottom. Test-heats of up to 150°F, all temperatures held to ±½°F, and results within 10% of



absolute duplication are other features claimed. H-T "Plexiglas" transparent lid can be opened from either direction or lifted off entirely. A completely transparent, all-Plexiglas model is also available. G. S. Equipment Co., 15583 Brookpark Rd., Cleveland, Ohio.

Print No. Ins. 136 on Reader Service Card

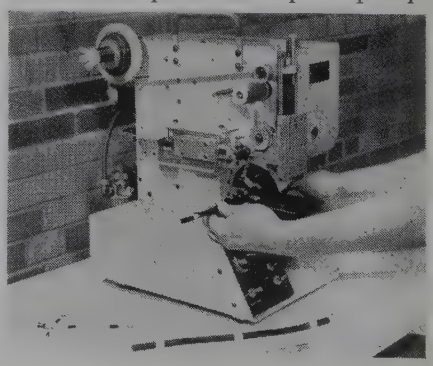
Semi-Automatic Test Station for Mass Spectrometer Leak Detector

A new test table is designed to make production leak detection a fast, foolproof operation with mass spectrometer leak detectors. An accessory that attaches directly to a mobile leak detector, the unit is intended to expedite production testing of capacitors, transistors, vacuum tubes, and nearly any other large or small device. Leak detection is said to be so simplified that production workers can use the unit efficiently after only one minute of instruction. Key to the device's simplicity is an arrangement of mechanical valves that affords all automatic features of more complex test stations. General Electric Co., Schenectady 5, N.Y.

Print No. Ins. 137 on Reader Service Card

Semi-Automatic Harness And Wire Taper

A semi-automatic machine for taping bundles of wires to form a taped harness applies pressure-sensitive tape to either single wires or bundles of wire. The taper makes spot tape ap-



plications of single or multiple wraps, revolving the tape around the bundle or wire. A production rate of up to 20 applications a minute on simple harnessing operations is claimed. Possis Machine Corp., 825 Rhode Island Ave. So., Minneapolis 26, Minn.

Print No. Ins. 138 on Reader Service Card

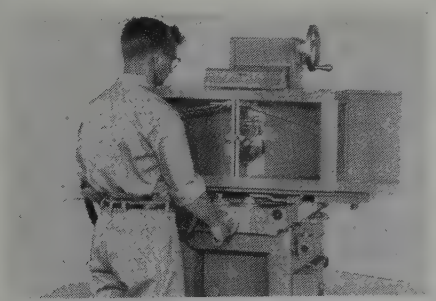
Calibrating Unit for Corona Test Sets

To conform to Mil C17-C in connection with the testing of coaxial cables, it is necessary to possess a means of periodically checking a corona test set to make certain that its sensitivity is 5 micro-micro coulombs/in scope deflection. Model CT-CAL-1 calibrating unit features a direct-reading dial calibrated in micro-micro coulombs that simplifies this measurement. The unit is composed of a pulse generator with a continuously adjustable and regulated output, and includes a corona-free calibrating capacitor rated at 25 kv rms. The output control has a linear scale, and is calibrated directly in micro-micro coulombs. Peschel Electronics Inc., Towners, Patterson, N.Y.

Print No. Ins. 139 on Reader Service Card

Slicing Machine for Ceramics

A new version of the precision "Microtom-atic" slicing machine, the MTM-612, is designed for more pro-



ductive slicing of silicon, germanium, quartz, ceramics, ferrites, and similar materials. The DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.

Print No. Ins. 140 on Reader Service Card

Inks for Marking Plastic Insulations

Several new inks are designed for marking and decorating "Delrin," silicone rubber, epoxy, "Kel-F," and "Teflon" with marking and printing equipment. Markem Machine Co., 158 Congress St., Keene, N.H.

Print No. Ins. 141 on Reader Service Card

New Literature

All catalogs, bulletins, and other literature or sample cards described are available free of charge. To obtain your free copies, just print the item number on the Reader Service Card on the back cover. Fill out and mail the card—no postage is required. Insulation *immediately forwards your requests to the companies concerned so that the literature can be sent to you promptly.*

Fiber Glass Yarn Brochure

Comprehensive brochure No. FTX-5A describes fiber glass manufacture from raw materials to eight different types of yarns and textile fibers—regular, colored, bonded strand, "Teflon"-coated, glass-"Dacron," asphalt saturated plus roving, chopped strand, and chopped strand mat with "Garan" and other binders. Physical properties of fiber glass and coding for fiber glass yarns are given. A fiber comparison chart details properties of glass, asbestos, cotton, nylon, and Dacron. In the yarn comparison table, extensive fiber glass continuous-filament yarn data are quoted. Sizing,

finishing, and packaging practices are described, and product usage illustrations are included. 12 pages. Johns-Manville, Fiber Glass Div., Textile Glass Dept., 1810 Madison Ave., Toledo 1, Ohio.

Print No. Ins. 201 on Reader Service Card

Booklet on Plastics

New booklet briefly describes many general-purpose resins, latices, and compounds and discusses present uses for these various products together with suggestions for new uses. Characteristics and processing of a high temperature vinyl are covered, and physical properties of a family of rigid acrylonitrile-butadiene-styrene resins and compounds are described. Also contained in the booklet are sections devoted to polyurethane materials, the first thermoplastic urethane material, and a thermoplastic colloidal mixture of a vinyl resin and a nitrile rubber. 20 pages. Advertising Dept., B. F. Goodrich Chemical Co., 3135 Euclid Ave., Cleveland 15.

Print No. Ins. 202 on Reader Service Card

Booklet on Reinforced Plastics Molding Methods

The six basic techniques used to mold reinforced plastics are explained

in a new letter-sized booklet. Intended as a convenient data guide for design engineers, purchasing agents, manufacturers, and others interested in reinforced plastic molding, the booklet describes each molding technique and lists its specific advantages and applications. Also given are physical and chemical properties of parts molded by each method. 10 pages. Reinforced Plastics Div., The Society of the Plastics Industry, Inc., 250 Park Ave., New York 17.

Print No. Ins. 203 on Reader Service Card

Data Sheet on Epoxy Adhesives

A new technical data sheet describes several 100% epoxy adhesives for use with many materials. Instructions are given for mixing and applying, and typical properties of the cured resins are listed. 2 pages. Isochem Resins Co., 221 Oak St., Providence 9, R.I.

Print No. Ins. 204 on Reader Service Card

Manual on Instruments and Methods To Predict Electrical Equipment Failure

Maintenance and inspection practices to foretell and prevent failure for many different types of electrical industrial equipment are described in a new manual. Amply illustrated by graphs, tables, and pictures, manual D-62 highlights methods and instruments for voltage breakdown tests and for measurement of insulation leakage at high voltage. Procedures for predicting life of motor and generator insulation, testing for breakdown of cable installations and rebuilt motors and generators are described. Precise performance data as well as case histories of actual applications in industry are included. Maintenance testing and life forecasting for insulation in motors, generators, cables, switchgear, transformers, capacitors, and electrical heating devices are covered. 52 pages. Associated Research Inc., 3777 W. Belmont Ave., Chicago 18.

Print No. Ins. 205 on Reader Service Card

Brochure on Applications of An Electronic Circuit Tester

Brochure outlines "Robotester" applications in electronic circuit checkout. Typical case histories cover uses, advantages and savings experienced in production line checkout, and operational testing of aircraft voltage regulators, missile electronic assemblies, aircraft assemblies, environmental testing, diode matrix systems, printed circuits, missile launching control, maintenance inspection, aircraft components, and airborne military equipment. 12 pages. Box 2, Lavoie Laboratories Inc., Morganville, N.J.

Print No. Ins. 206 on Reader Service Card

Bulletin on Connectors With Nylon Housings

Bulletin 341 describes a new line of multiple circuit connectors with nylon housings which feature high amperage ratings plus low insertion and extraction forces. Photographs and a general description of the new connectors are given, and potential applications in the appliance, electrical, electronic, and power equipment fields are discussed. Features of the brass contacts and of the nylon housing are enumerated and detailed specifications are given. Photographs show tools for crimp attachment of contacts to circuit leads. 2 pages. AMP Inc., Harrisburg, Pa.

Print No. Ins. 207 on Reader Service Card

Manual on Designing With Die Stamped Circuits

"Designing With Die Stamped Circuits" is the title of new bulletin No. D1. The first section compares each of the features of die stamped circuits with those made by etching copper-clad laminated plastics. The second section gives hints for the design of die stamped circuits, including layout, fabrication, artwork, nomenclature, and current carrying capacity. Also included in this section are standard tolerances for fabricating die stamped circuits. The final section gives definitions for the most common terms used in printed circuit design. 12 pages. Dytronics Inc., 115 Main St., Rochester, Mich.

Print No. Ins. 208 on Reader Service Card

Folder on Pin-And-Socket Multiple Connectors

An illustrated folder describes a complete line of pin-and-socket type multiple connectors. The folder details the electrical and mechanical characteristics and lists the salient features of the five types of contacts available and the features of the connector shells and inserts. A list of the connector accessories available is also given. 6 pages. AMP Inc., Harrisburg, Pa.

Print No. Ins. 209 on Reader Service Card

Data Sheet on Method of Making Polyethylene Bondable with Epoxy

New data sheet, TSB-3-625-1060, describes a new method developed for rendering polyethylene surfaces bondable with two epoxy adhesives. The new method should be of interest in encapsulation of electronic components and applications where bondable "Teflon" was formerly utilized. 2 pages. Mereco Products Div., Metachem Resins Corp., 530 Wellington Ave., Cranston 10, R.I.

Print No. Ins. 210 on Reader Service Card

Brochure Describes, Classifies Coated Class A Electrical Insulating Materials

A new brochure describes coated insulating products for class A temperature applications. It covers standard class A coated constructions for 105°C continuous operating temperatures such as varnish coated cotton cloths, silks, canvas, and fine papers. Also listed are several special thin varnished constructions, along with descriptions of standard and special surface finishes available. A chart lists typical properties. 6 pages. Irvington Div., Minnesota Mining and Manufacturing Co., 900 Bush Ave., St. Paul 6, Minn.

Print No. Ins. 211 on Reader Service Card

Voltmeter Bulletin

Bulletin GEZ-3254 describes features and application of type DB-18 a-c, new, expanded-scale voltmeter. Specifications, dimensions, and prices are detailed. 2 pages. General Electric Co., Schenectady 5, N.Y.

Print No. Ins. 212 on Reader Service Card

Catalog of Connector Cables And Other Electronic Components

New illustrated catalog #1060 covers electronic components, connectors, switches, and hardware. Complete descriptions and specifications on all items are included. Featured is information on the use and availability of color-coded connector cables. 8 pages. Zoron Inc., 612 West Monroe St., Chicago.

Print No. Ins. 213 on Reader Service Card

Data Folder on High-Altitude, High-Voltage Leads and Terminals

Complete specifications for a new line of leads and terminals developed for high-altitude, high-voltage power transmission requirements are given in a new folder. Terminal specifications for both canned and encapsulated power transmission units are listed, with extensive cutaway illustrations to show the kinds of assembly configurations available. Specifications are also given for HA/HV leads, with custom-made end connectors to meet individual needs. 6 pages. AMP Inc., Harrisburg, Pa.

Print No. Ins. 214 on Reader Service Card

Vacuum Oven Data Sheet

New data sheet describes outstanding features of a newly designed vacuum oven for rapid drying and treatment of heat-sensitive materials, testing and conditioning of electronic parts, and processing of plastics. Complete specifications are given. 2 pages. The Electric Hotpack Co. Inc., Cottman Ave. at Melrose St., Philadelphia 35, Pa.

Print No. Ins. 215 on Reader Service Card

Laboratory Apparatus Catalog

Apparatus Review 12 covers many laboratory instruments: spectrophotometers, pH meters, electrobalances, recorders, tensile and compression test machines, and related equipment. 16 pages. Arthur S. LaPine and Co., 6001 S. Knox Ave., Chicago 29.

Print No. Ins. 216 on Reader Service Card

Circular Slide Rule

A circular slide rule for engineers and other plant and office executives is a convenient, pocket-size calculator that can be used to multiply, divide,

and find proportions. Easy-to-follow instructions included. General Industrial Co., 1788J Montrose Ave., Chicago 13.

Print No. Ins. 217 on Reader Service Card

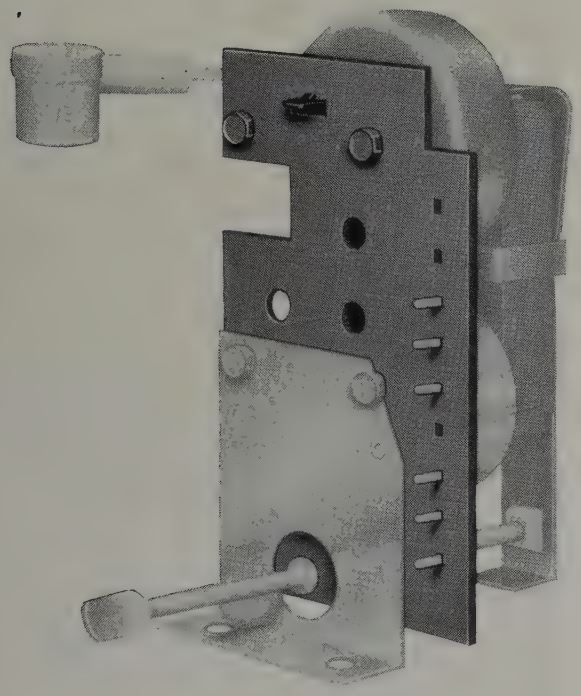
Reinforced "Teflon" Used in Satellite

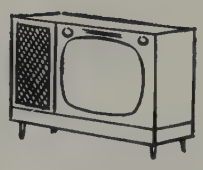
Credit for the successful flight of Discoverer XIII is shared by a material specifically designed to send and receive electronic signals while withstanding the extreme temperature variation and friction of space travel.

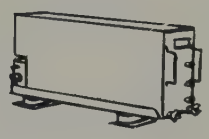
Produced by Rogers Corp., the material—a combination of "Teflon" and ceramic fibers—was used in the second stage of the Discoverer as beacon antennae. The entire second stage was sent into orbit. The material was selected because of its electrical properties and its ability to ablate uniformly under the tremendous speeds, pressures, and temperature changes encountered during orbiting and when leaving and entering the earth's atmosphere.

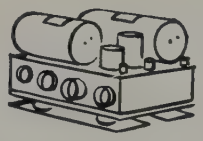
The antennae are designed to serve in the transmitting and receiving of signals during the flight portion of the 19.2-foot satellite and as part of the beacon signal during the recovery period.

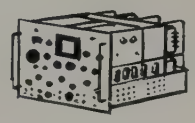
NEW SPAULDITE XXXP-770 PHENOLIC LAMINATE COMBINES *COLD PUNCHING* AND *FIRE RESISTANCE* . . . COSTS LESS THAN PAPER EPOXIES











TYPICAL PROPERTIES OF XXXP-770 — 1/16″ Thickness

Thickness Range	1/32 - 3/16″
Punching Quality	Cold
Shearing Quality	Cold
Water Absorption %	0.65
Dissipation Factor 1 MC	
Condition A	.029
Condition D-24/23	.034
Dielectric Constant 1 MC	
Condition A	4.4
Condition D-24/23	4.6
Dielectric Strength Parallel to Plys KV	
Condition D-48/50	49
Rockwell Hardness M Scale	
Condition A	78
Flame Test D635 Inches Burned	
(in 2 ignitions after 28 days at 135°C)	5/8

COPPER CLAD XXXP-770

Surface Resistivity — ohms/cm sq.	
Condition C-96/35/9	1 x 10^{13}
Peel Strength as rec'd and after solder dip	
lbs./in. width	8.0
Solder Blister at 500°F Seconds	15.0

Because Spaulding can fabricate XXXP-770 with lower cost cold punching methods, this new phenolic laminate offers you greater savings and efficiency in the design and production of high volume electronic parts that require self-extinguishing characteristics.

Write for complete data on Spauldite XXXP-770 and Spaulding's other fire-resistant grades.

SPAULDING FIBRE COMPANY, INC., 310 Wheeler Street, Tonawanda, New York

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Dates to Circle

Meeting and Convention Notices

Jan. 9-11 . . . AIEE-IRE-ASQC, 7th National Symposium on Reliability and Quality Control, Bellevue-Stratford Hotel, Philadelphia.

Jan. 16-18 . . . American Astronautical Society, 7th Annual Meeting, Sheraton-Dallas Hotel, Dallas, Texas.

Jan. 16-20 . . . Western Winter Radio-Television & Appliance Market (Division of Western Home Goods Market), Western Merchandise Mart, San Francisco, Cal.

Jan. 23-27 . . . Gaillard Seminar on Industrial Standardization, Engineering Societies Building, New York City.

Jan. 24-27 . . . SPE, 17th Annual Technical Conference, Shoreham and Park-Sheraton Hotels, Washington, D.C.

Jan. 29-Feb. 3 . . . AIEE, Winter General Meeting, Hotel Statler, New York City.

Jan. 30-Feb. 3 . . . ASTM, Committee Week, Netherland-Hilton Hotel, Cincinnati.

Feb. 1-3 . . . 2nd Winter Military Electronics Convention, sponsored by the National Professional Group on Military Electronics and the Los Angeles Section of IRE, Biltmore Hotel, Los Angeles.

Feb. 5-11 . . . National Electrical Week.

Feb. 7-9 . . . SPI, 16th Reinforced Plastics Division Conference, Edgewater Beach Hotel, Chicago.

Feb. 15-17 . . . AIEE, IRE, and the University of Pennsylvania, International Solid-State Circuits Conference, University of Pennsylvania and the Sheraton Hotel, Philadelphia, Pa.

Feb. 20-25 . . . International Symposium on Semiconductor Devices, UNESCO, 2 Place Fontenay, Paris, France.

Feb. 26-Mar. 1 . . . First Annual Pacific Electronic Trade Show, Great Western Exhibit Center, Los Angeles.

Mar. 9-10 . . . Symposium on Engineering Aspects of Magnetohydrodynamics, AIEE, IAS, IRE, and Univ. of Pa., University Park, Philadelphia, Pa.

Mar. 15-17 . . . EIA, Spring Conference, Washington, D.C.

Mar. 20-23 . . . IRE, National Convention, Coliseum and Waldorf-Astoria Hotel, New York City.

Mar. 21-25 . . . Electrical Engineers Exhibition, Earls Court, London. For information, contact Electrical Engineers Exhibition Ltd., 6 Museum House, 25 Museum St., London, W.C.I.

Apr. 5-7 . . . AIEE, South East District Meeting, Jung Hotel, New Orleans, La.

Apr. 5-7 . . . ASTM, Symposium on Materials and Electron Device Processing, Benjamin Franklin Hotel, Philadelphia.

Apr. 10-11 . . . Rubber and Plastics Industries Conference, Sheraton Hotel, Akron, Ohio.

Apr. 17-21 . . . American Welding Society, Annual Convention and Welding Exposition, Commodore Hotel and New York Coliseum, New York City.

Apr. 19-21 . . . AIEE, Great Lakes District Meeting, Hotel Pick-Nicolett, Minneapolis, Minn.

Apr. 20-21 . . . SPI, 18th Annual Western Section Conference, Hotel del Coronado, Coronado, Cal.

Apr. 26-28 . . . IRE, 7th Region Technical Conference & Trade Show, Westward Ho Hotel, Phoenix, Ariz.

Apr. 30-May 4 . . . Electrochemical Society. Spring Meeting, Claypool Hotel, Indianapolis, Ind.

May 1-2 . . . AIEE, Rural Electrification Conference, Kentucky Hotel, Louisville, Ky.

May 2-4 . . . Electronic Components Conference, AIEE, IRE, EIA, and WEMA, Jack Tar Hotel, San Francisco.

May 7-8 . . . IRE, 5th Midwest Symposium on Circuit Theory, University of Illinois, Urbana, Ill.

May 8-10 . . . IRE, NAECON, Miami and Biltmore Hotels, Dayton, Ohio.

May 9-11 . . . Western Joint Computer Conference, sponsored by AIEE, IRE, and Assoc. of Computer Manufacturers, Ambassador Hotel, Los Angeles.

May 17-19 . . . AIEE, North Eastern District Meeting, Statler Hotel, Hartford, Conn.

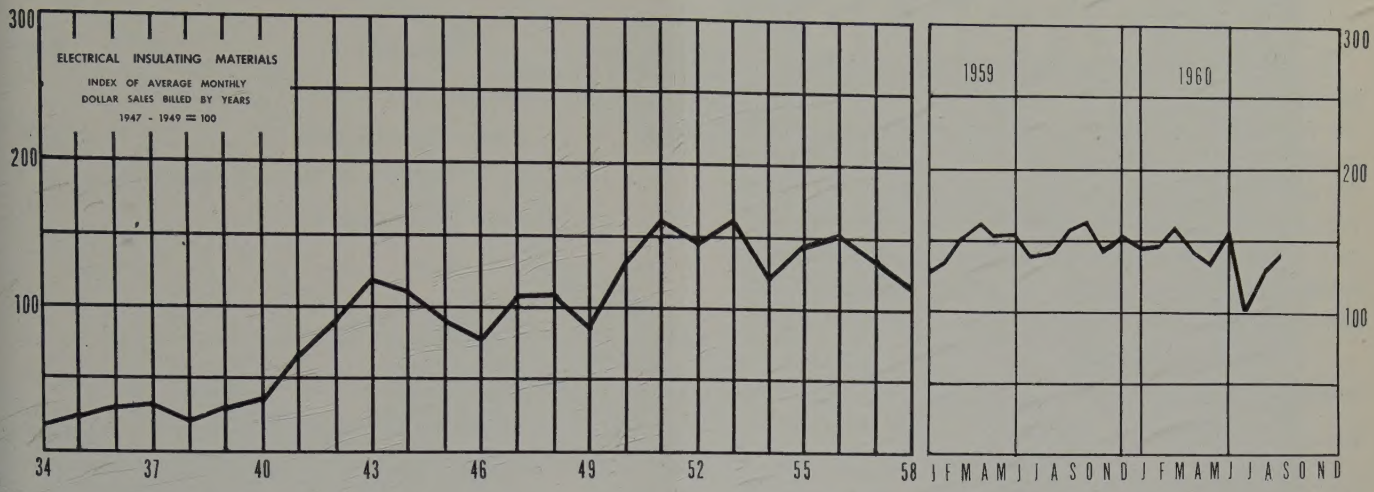
May 23 . . . AIEE, Fractional Horsepower Motors Conference, Biltmore Hotel, Dayton, Ohio.

May 24-26 . . . EIA, 37th Annual Convention, Chicago.

Abbreviations Used in Notices

AIEE	—American Institute of Electrical Engineers	NEMA	—National Electrical Manufacturers Assn.
ASTM	—American Society for Testing Materials	NISA	—National Industrial Service Assn.
ASME	—American Society of Mechanical Engineers	SPE	—Society of Plastics Engineers
ASA	—American Standards Assn.	SPI	—Society of the Plastics Industry
IRE	—Institute of Radio Engineers	WEMA	—Western Electronic Manufacturers Assn.
EIA	—Electronic Industries Assn.		

NEMA Electrical Insulation Index



	Sept. '60	Aug. '60	Sept. '59
Index Series	142	131	160
Sept. '60 point change from other mos.		+11	−18
Sept. '60 % change from other months		+ 8	−11

Index is based on 1947-1949 average month, inclusive= 100

Published through the courtesy of the National Electrical Manufacturers Association

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Manufactured Electrical Mica
Varnished Fabric and Paper
Vulcanized Fibre
Coated Electrical Sleeving

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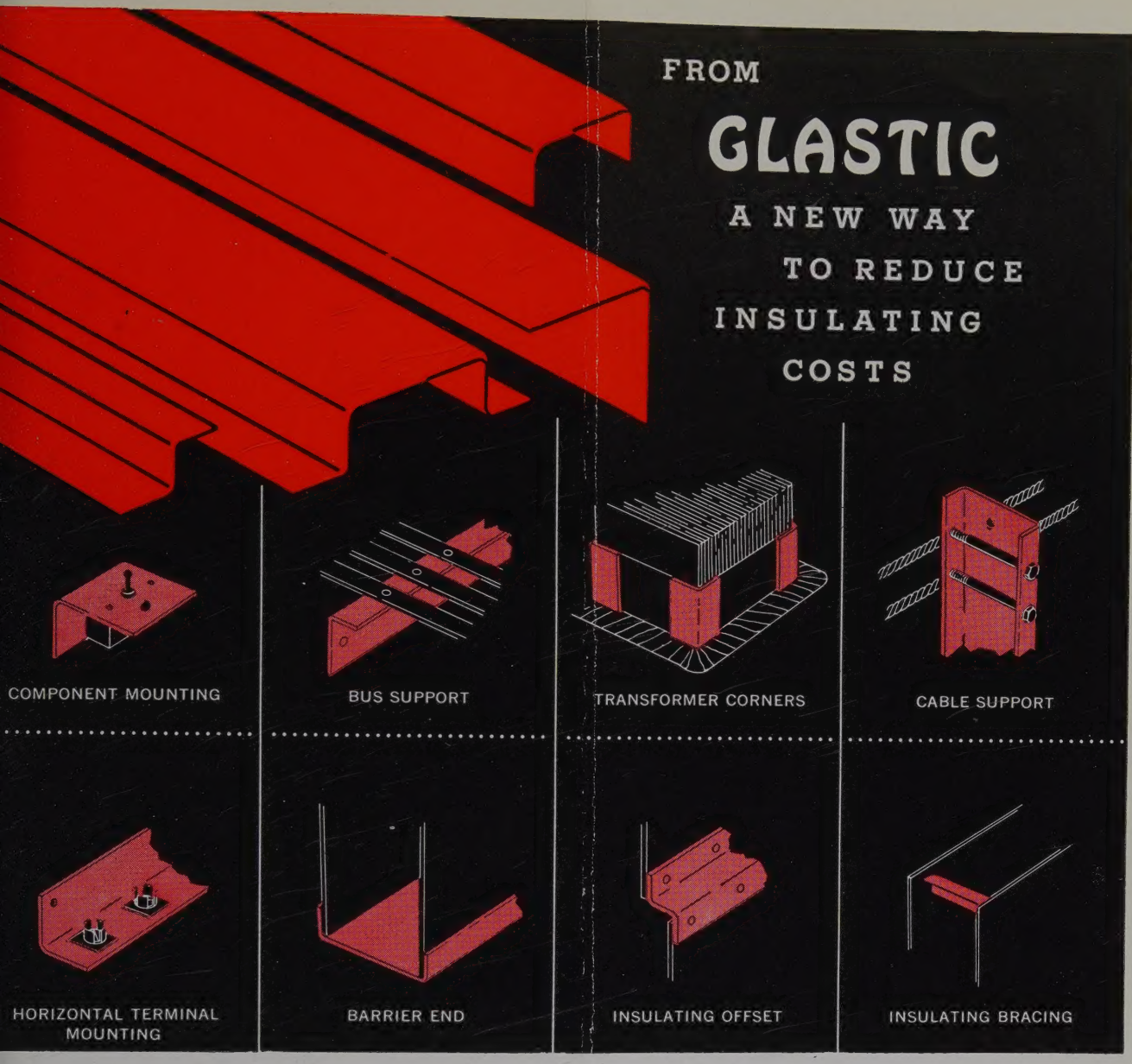

Use versatile channel/angle stock for design flexibility, simplified assembly

The illustrations show typical ways in which Glastic insulating channel and angle stock can serve as product-improving replacements for heavier or more expensive forms—stand-off insulators, wood or insulated metal members.

The high strength stock is available off-the-shelf only from Glastic. It comes ready-to-use in 10 sizes, in widths to 9⅝" and lengths to 76". It can be easily fabricated to meet individual job requirements.

Glastic structural stock is molded of fiber glass reinforced polyester and is engineered for use in equipment operating at Class B temperatures (130°C). It has UL-recognized flame retardance, and properties meet NEMA GPO-1 specifications.

Investigate the cost-saving possibilities of these easy-to-use insulating shapes in your applications . . .

SEND FOR COMPLETE DATA

"Insulating Channel and Angle Stock" Catalog contains application, engineering and price information. Companion catalog describes Glastic line of low cost insulators.

THE GLASTIC® CORPORATION

4321 Glenridge Road Cleveland 21, Ohio

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per magnet wire, compressed into a coil scarcely a quarter of an inch in diameter, transforms the balance wheel into a miniature motor.

The *HAMILTON* electric... the world's first electric wrist watch!

It was inevitable that an electric power source would take its place alongside the other power sources used in the search for more accurate timepieces.

The Hamilton Electric Watch is the newest of all modern timepieces. It is approximately the same size and shape as a conventional wrist watch. It is of simpler construction, has fewer parts, and is remarkably precise. A tiny energy cell or battery, no larger than a shirt button, will keep the watch running for more than a year. Actually, the electric watch is nothing more than a tiny electric motor running constantly at a controlled speed. The motor coil contains 121 feet of the finest copper magnet wire and the tiny contact points make and break the circuit 216,000 times a day.

REA MAGNET WIRE COMPANY is proud to have contributed to the successful production of this outstanding timepiece by supplying mile after mile of ultra-fine magnet wire of constant quality for these precision instruments.

REA ultra-fine magnet wires are available as fine as AWG #58 (0."00038), in both copper and aluminum.

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